AUTOMOTIVE INDUSTRIES

Founded 1895

Vol. 75, No. 22

November 28, 1936

This Week

The effects of jack-knifing of tractor trailers is the subject of an article by P. M. Heldt beginning on page 739. The why's and wherefore's make interesting reading.

"Bill" Stout has said that passenger car engines cannot be moved back gradually and now Athel F. Denham points the way to how it can be done. He even goes so far as to say that perhaps that is just what is taking place. Turn now to page 742.

Another article of the series on automobile advertising by Thomas G. MacGowan will be found on page 746.

On page 751 there are more mechanical specifications of 1937 passenger cars and on page 753 are the drawings of the new Chrysler Royal engine.

Strike Effects Confined

Bendix Tie-Up Fails to Curb Expanding Production; Output of 430,000 Vehicles Likely During Month

By Harold E. Gronseth

The rapidly expanding production of the automobile industry continues uninterrupted by the closing of one of the leading parts plants on account of labor troubles. In most cases, the car manufacturers carried sizable stocks of the parts supplied by the strike-bound Bendix plant in South Bend. Moreover, experiences in recent years have taught them the value of having more than one string to their bow. If one source is cut off, as a rule they are in position to draw more heavily upon other sources or, if necessary, to set up quickly machinery for manufacture of the parts in their own plants. Both procedures are now being resorted to.

With production having attained a faster clip than a year ago, the increased output of the last half of November more than makes up for the lag during the first half of the month. It appears reasonably certain that the current month's total will top that of November last year by a comfortable margin and will run 200,000 units better than in October this year when, according to official figures released this week, 229,989 cars and trucks were built. It is estimated that production this month will run in the neighborhood of 430,000 units which compares with 408,550 built in November, 1935.

Thus the first 10 months this year have accounted for 3,692,023 cars and trucks and, if the November projection is realized, 11 months will bring the total to 4,122,000 units, leaving 478,000 to be turned out in December if the goal of 4,600,000 vehicles for 1936 is to be reached.

Except for holiday closings and brief interruptions for year-end inventory, there is likely to be little slowing down in the production pace this winter. The factories are working on one of the biggest banks of unfilled orders they have ever accumulated. Authorities estimate these unfilled orders will keep them busy until the end of January. A minor slackening might take place in February, depending on weather conditions. By that time, however, many will be thinking about building up stocks for the heavy spring business, so that with reasonably good winter demand most plants expect to maintain production at a high level for many months. Threat of higher prices will act as an inducement for dealers to carry heavy stocks, which is another factor in the production plans.

Graham retail sales for the first 10 days of November show a 60 per cent increase over the figures for the similar period last year. Fourth quarter shipments through Nov. 21 of this year come within 165 units of equaling the total for the entire three months of the 1935 final quarter. "Graham shipments for the remainder of 1936 will enable us to come within a very few cars of equaling the peak final quarter in Graham history, that of 1928 when 7900 units were shipped," declared Lansing W. Thoms, assistant general sales manager.

"Better than 130 per cent more Oldsmobile sixes and eights are being sold at current automobile shows

(Turn to page 738, please)

Bendix Strike Settled

Union Accepts Compromise Worked Out by Officials

Bendix workers were to resume work Friday morning, Nov. 27, according to an agreement reached late Wednesday between union officials and Bendix executives. A compromise agreement, details of which were not revealed, had been reached earlier in the day and submitted to the union for final consideration. The union voted to accept the agreement.

First step toward a settlement came Monday afternoon when the self-imprisoned union workers marched from the factory singing songs after nearly a week spent inside the walls. Union leaders had addressed the men prior to the evacuation. The union placed guards around the plant both for the protection of Bendix interests and those of the union. Principal issue involved was "the right of the United Automobile Workers to become the sole bargaining agent at the plant."

Negotiations were conducted secretly between Bendix officials and officers of the union in the presence of conciliators from the Department of Labor.

Firestone Buys GM Memphis Plant

The Firestone Tire & Rubber Co. has purchased the General Motors body plant at Memphis, Tenn., and will equip it for the manufacture of tires. A schedule of 2000 daily is planned.

$60 for Steel

The Steel Institute states that automobile manufacturers will pay $60,000,000 less this year for steel for bodies than 10 years ago, representing a 30 per cent decline in the price of high grade body sheet steel since the continuous rolling mill was introduced in 1926. Average increase of steel used in new cars against 1926 is 65 lb. Eighty per cent of the weight of the average car is steel though only about $60 of its cost is represented by steel, say steel men.

An Accessory Alphabet for Amateurs

By Berton Braley

A is for Ammeter (when it won't operate
Pay the ignition-man's honest and proper rate).

B is for Battery—all that I know
Is that without it your motor won't go.

C is for Crankshaft, which—let me be frank—
Has something to do with a shaft and a crank.

D—for Distributor, when it won't function
Your cylinders don't seem to work in conjunction.

E's for Exhaust, that's the pipe in the rear
Which frequently smokes when you're changing the gear.

F is for Forgings which salesmen at length
Extol as a means of endurance and strength.

G is for Gears, which are cogwheels and such,
I couldn't explain how they operate, much.

H—High Compression; I read it in ads
But what it may mean I can't tell you, my lads.

I is Ignition (see A, B, and D—
The whole thing's a terrible puzzle to me).

J is for "Jigger," a word that will fit
Most any old gadget whose name I fergit.

K is for Knock, which is mostly caused by
Some trouble with either A, B, D, or I.

L—Lubrication, I know this about it,
You burn out a whole lot of bearings without it.

M is the Motor, which, I've understood,
Is what you find when you look under the hood.

O is the Overhead Camshaft. I am
Unable to tell you the meaning of "cam."

P is for Pistons, cylindrical things,
Which every so often need costly new rings.

Q is for Questions I ask with a will
And after the answers, stay ignorant still.

R is—at least so they tell me—the Rotor.
I can't tell you where it is found on the motor.

S—the Speedometer—dial of speed,
Which traffic laws sometimes compel us to heed.

T's for Transmission. Its mysteries are
Concealed in the doodad down under the car.

U—Universals—though just what they do
Is Greek to Yours Truly and maybe to U.

V is for Valves, which are gadgets, I've found,
That gather up carbon and have to be ground.

W—Wiring, a tangled-up mess
Whose wanderings I cannot follow or guess.

X is the X-cellerator, you push
And a motor-cop starts from behind every bush.

Y is the Yahoo who drives with his horn,
Treating your various signals with scorn.

Z is for Zero, which, as I reveal,
Sums up what I know of my automobile.

New World Records Made by Caracciola on Mercedes-Benz

New world's road records for the kilometer and the mile with flying start and for 5 km. with flying start were hung up by Rudolph Caracciola with a new 60-hp. Mercedes-Benz racing car on a section of the superhighway between Frankfort and Darmstadt, Germany, on Oct. 26. The highway was closed to regular traffic for the occasion.

The new flying-start 1-km. record is 9.88 sec., which corresponds to a speed of 226.42 m.p.h. and supersedes Nuvolari's record corresponding to 199.73 m.p.h. The new flying-start mile record is 15.785 sec., corresponding to 228.07 m.p.h. and supersedes Nuvolari's record of 200.78 m.p.h. The new 5-km. flying-start record is 52.85 sec. and supersedes Hans Stueck's record of 194.13 m.p.h. the speed corresponding to the new time for the 5 km. being 211.62 m.p.h.

The new car is equipped with a 12-cylinder engine of 341 cu. in. piston displacement. Its two banks of cylinders are provided each with a supercharger. The engine is said to turn over at 7000 r.p.m., and with a rear-axle ratio of 2.8 it gives the driving wheels a speed of 2500 r.p.m. These latter are provided with new Continental racing tires which have no treads.

It is understood that Caracciola will make an attempt on other world's records, including those for 1 km. and 1 mi. with standing start and those for 5 and 10 mi. and 5 km. with flying start.

Canadian Ford Dividend Of $1 per Share Voted

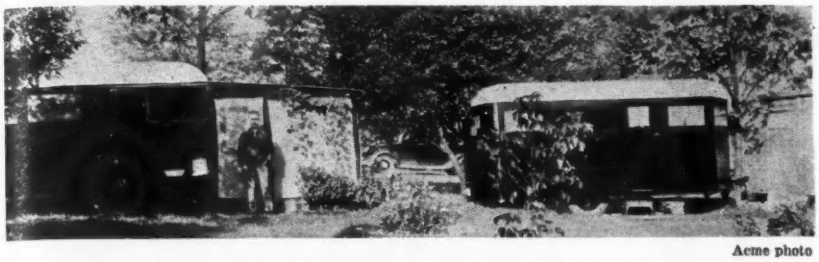
Because of increased earnings in 1936 and an improved general business outlook, directors of the Ford Motor Co. of Canada, Ltd., Windsor, Ont., placed the stock on a quarterly dividend basis of 25 cents a share, equivalent to $1 a year, Wallace R. Campbell, president, has announced. At the same time directors declared an original dividend of 25 cents a share payable Dec. 16 to shareholders of record Nov. 28. The previous dividend paid by the company was 75 cents a share on July 11, 1936. In 1935, the only payment was 50 cents.

Capitalization of the company consists of 1,588,960 Class "A" non-voting and 70,000 Class "B" voting shares of no-par-value, a total of 1,658,960 shares.

Nuvolari Not to Race In U. S. in September

Tazio Nuvolari, winner of the Vanderbilt Cup race, together with his team mates, will not be allowed to run in next year's race, scheduled for Sept. 5, on Roosevelt Raceway. This action has been taken by the Italian club in reply to the change of date by the American Automobile Association from October to September.

For a number of years Italy has held its Grand Prix on the Monza track on



Acme photo

The trailer home of Hildred Gumarsol, Pontiac factory worker, in which he lived at Orchard Lake, Mich., has been held illegal under Michigan's housing laws. Gumarsol had removed the wheels from his trailer and built an addition alongside it. "Dwellings" in Michigan must have 500 cu. ft. of space per occupant.

Additional Chrysler '37 Model Prices Announced

Additional prices on the 1937 Chrysler line have been anounced by J. E. Fields, president of the Chrysler sales division of the Chrysler Corp. as follows:

Chrysler Royal conv. coupe	$ 910
Chrysler Royal 7-pass. sedan	1,045
Chrysler Royal 7-pass. sedan limousine	1,145
Chrysler Royal conv. sedan	1,245
Chrysler Imperial conv. coupe	1,065
Chrysler Imperial conv. sedan	1,395
Chrysler Custom Imperial 7-pass. sedan	1,895
Chrysler Custom Imperial 7-pass. sedan limousine	1,995

Sept. 12. As it is impossible for drivers to take part in both races, the Italian club has decided that its men shall be kept at home. This action is made possible by a national rule that no driver shall compete abroad without the permission of his national club. Originally designed to protect national prestige, this is the first time the rule has been applied to meet the competition of other tracks.

Carl Henry Leis

Carl Henry Leis, chief engineer and factory manager of the Johnson Bronze Co., died at his home in New Castle, Pa., Nov. 11, at the age of 45 years. He was born in Germany and came to this country in 1917. He was associated with the Johnson Bronze Co. since 1927.

Mr. Leis was well known throughout engineering circles where he has been regarded as a leading authority on bearings and bearing bronze.

Retail Automotive Sales Gain 60%

Preliminary Census Figures Show 35,017 Car Dealers in '35, Doing 82% More Business Than in '33

Aggregating $4,626,564,000, retail sales of automotive products in 1935 reflected an increase of 60 per cent over 1933, according to William L. Austin, director of the Bureau of the Census, in a national summary of the preliminary retail census for the United States. The report was made public Wednesday by Secretary of Commerce Roper. Covering all retail sales totaling $32,790,267,000, the 1935 increase over 1933 was 31 per cent. The figures include preliminary returns from five states where the field canvass is still in progress. Scattered schedules from other states, received after the respective state reports were issued, are also omitted. The final census report will be published as soon as completed, it was announced, and will contain these additional returns with a corresponding increase in totals.

In the automotive group, the 1935 classification is somewhat different from that of 1933 which listed garages that later became automobile sales agencies.

The number of motor vehicle dealers increased from 30,646 in 1933 to 35,017 in 1935 and their sales increased 82 per cent. Total retail sales by the automotive group while showing a sharp gain over those of 1933 were 63 per cent below those of 1929 when they aggregated $7,828,387,000.

A comparison of stores, sales, personnel and payroll in the automotive group in 1935 and 1933 is given in the accompanying table.

	Number of stores	SALES		Number of proprietors	EMPLOYMENT AND PAY ROLL						Total reported expense (except proprietors' compensation)
					Full-time employees			Part-time employees		Total pay roll (full-time and part-time)	
		Amount	Per cent of total		Average number	Pay roll	Average per year per employee	Average number	Pay roll		
1933											
AUTOMOTIVE GROUP	305,403	$4,419,249	17.7	309,086	432,989	437,701	$1,011	65,383	$26,845	$464,546	$1,021,965
Motor-vehicle dealers (new and used)	30,646	2,127,720	8.5	33,823	190,691	198,542	1,041	12,671	6,276	204,818	420,212
Accessories, tire and battery dealers	16,027	225,970	.9	15,626	25,341	26,210	1,113	3,543	1,386	29,596	69,189
Filling stations	170,404	1,531,724	6.1	156,451	143,391	141,903	990	28,421	10,035	151,938	342,233
Motorcycle, bicycle, and supply dealers	1,560	9,786	.1	1,694	1,064	1,034	972	279	119	1,153	2,951
Garages and repair shops	86,454	519,827	2.1	101,175	71,904	67,267	936	20,299	8,949	76,216	185,732
Other automotive	312	4,222	.....	317	598	745	1,246	170	80	825	1,648

	Number of stores	SALES		Active proprietors and firm members	Employees (full-time and part-time) Avg. for year	PAY ROLL (add 000)		
		Amount (add 000)	Per cent of total			Total	Full-time	Part-time
1935								
AUTOMOTIVE GROUP	116,553	$4,626,564	14.1	113,149	376,774	$436,305	$423,486	$12,819
Motor-vehicle dealers (new)	30,265	3,750,731	11.4	25,489	256,627	314,442	309,219	5,223
Used car dealers	4,752	121,168	.4	4,733	9,783	10,685	10,042	643
Accessories, tire and battery dealers	14,285	371,190	1.1	10,370	45,431	54,135	52,357	1,778
Garages	66,183	368,404	1.1	71,571	62,926	54,775	49,732	5,043
Other automotive	1,068	15,071	.1	986	2,007	2,268	2,136	132
FILLING STATIONS	196,649	1,961,780	6.0	179,811	201,611	174,409	163,046	11,363

AAA for Sane Laws

Protests Unfair Taxes, Parking Meters, Highway Lighting

The American Automobile Association closed its two-day convention at the Hotel Statler in Detroit, Nov. 14, after going on record against taxation and other discriminatory legislation.

Resolutions were directed against such things as parking meters, wholesale lighting of highways and compulsory fingerprinting of motorists.

The association opposed efforts to have 100,000 mi. of trunkline highways lighted because the expense involved would prevent other improvements considered more necessary. It was estimated that 10 years of such a lighting program would cost more than $1,300,000,000, taking funds which could be used for separated lane roads and grade crossing elimination.

A resolution "earnestly requested" the Federal Government to cease designating a government agency by the initials which since 1902 have been the trade-marked emblem of the American Automobile Association.

A nine-point bill of rights for motorists was adopted, establishing a basis on which the AAA will approach automobile legislation in Congress and the legislatures. The theme is mainly taxation. A detailed highway safety program was adopted following receipt of a letter from President Roosevelt in which he said that "protection of life and property on our highways is a paramount national problem."

"The automobile is progressing so rapidly that the 1937 car will be more of an antique in 10 years than the car of 20 years ago is today," W. J. Cameron of the Ford Motor Co. told more than 1000 delegates and guests at the annual dinner of the association Friday night. "The most romantic feature of the automobile business," said Cameron, "is that despite the more than 30 years of its history, the automobile is still new because the industry has shaken off control of moneyed interests to remain loyal to the engineers' ideal that a useful thing will always find its user."

Henry Ford was honor guest at the dinner meeting, the first AAA convention he has attended. Thomas P. Henry of Detroit, perennial president of the association, was reelected to his 14th term. The seven vice-presidents also were reelected. J. L. Young of Cleveland was chosen secretary, and G. W. White of Washington, treasurer.

Acme photo

Owner Bernard Greenberg of a New York bus line took the wheel himself during a recent strike when drivers picketed for a 10-cent per hour pay increase.

:SLANTS:

HIT AND HIT AGAIN—*What's wrong with the driver who has one accident after another will be the subject of a joint study to be made by the Bureau of Public Roads and the Highway Research Board of the National Research Council. Nationally known traffic specialists and psychologists will be enlisted to find out what puts a driver in the high-accident class. Experience has shown that certain drivers have more than their share of accidents, without in many cases being responsible for them, apparently. Study of statistical data and tests of the drivers' physical reactions are expected to throw much light on the problem.*

"THANKS A MILLION"—*This was Chevrolet's appropriate greeting to America in newspaper display advertisements this week. "The builders of Chevrolet are thankful for many things, but most of all for the warm friendship of the American people. . . . All we can do is offer you the still finer Chevrolet of 1937 in return for the finest friendship ever bestowed upon any motor car manufacturer," the ad continued.*

75 PER CENT DEFECTIVE—*A survey just made by the National Bureau of Casualty and Surety Underwriters shows that 75 per cent of all motor vehicles in operation have some defects. Commonest fault: tires, near the danger point on 50 per cent of the cars inspected; most dangerous defect: brakes, with 39 per cent unsafe. In the survey, 22,702,000 vehicles, both cars and trucks, were inspected for brakes, lights, horns, steering gears, windshield wipers and rear vision mirrors.*

STATE TAX BILL—*Nearly a billion dollars were paid by motor vehicle users in special state taxes during 1935, the exact sum being $950,971,000, according to reports of state officials to the Bureau of Public Roads. Of this amount, $761,533,000 was allocated for highway purposes, by far the largest source of highway revenue. A total of $147,142,000 was diverted for non-highway purposes. Costs of administration and collection were $31,761,000.*

Ten Months' Output Gained 12%

Passenger Car and Truck Production—U. S. and Canada

	October, 1936	September, 1936	October, 1935	First Ten Months, 1936	First Ten Months, 1935
Passenger Cars—U. S. and Canada:					
Domestic Market—U. S.	173,955	83,899	195,568	2,743,964	2,406,268
Foreign Market—U. S.	16,733	6,698	17,742	164,624	166,040
Canada	4,592	2,481	6,803	104,680	113,980
Total	195,280	93,078	220,113	3,013,268	2,686,288
Trucks—U. S. and Canada:					
Domestic Market—U. S.	25,706	37,892	47,114	547,973	472,767
Foreign Market—U. S.	8,234	6,641	11,619	104,363	102,272
Canada	769	2,174	1,470	26,419	31,617
Total	34,709	46,707	60,203	678,755	606,656
Total—Domestic Market U. S.	199,661	121,791	242,682	3,291,937	2,879,035
Total—Foreign Market—U. S.	24,967	13,339	29,361	268,987	268,312
Total—Canada	5,361	4,655	8,273	131,099	145,597
Total—Cars and Trucks—U. S. and Canada	229,989	139,785	280,316	3,692,023	3,292,944

ICC Upholds Rail-Truck Plan

Keeshin-Chicago Great Western Join Rate Arrangement Held Benefit to Shippers and Public

Holding that the plan would mean increased revenue on less-than-carload shipments of the Chicago Great Western Railroad, the Interstate Commerce Commission in a decision Nov. 23 approved the arrangement between that carrier and the Keeshin trucking interests for joint motor-rail-motor rates. Traffic will move under these rates by motor trucks from points in the Northeast to Chicago where trucks and trailers will be placed on railroad flat cars to be carried to St. Paul, Minneapolis and Des Moines and points between. The trucks and trailers then will be unloaded and carry the freight to final destinations by highway, the rates to be the same as the Keeshin all-highway rates.

Suspension of the rates was ordered last spring by the commission when it held the rates were justified and approved suspension of the long-and-short haul clause of the fourth section of the Interstate Commerce Act. Meanwhile the commission entered upon an investigation of the plan, which it declared to be novel. Its decision was in the nature of vacating the suspension of the rates.

The majority opinion, written by Commissioner Splawn, said that while it is the duty of the commission to determine whether or not the rates and charges proposed would be unlawful, "we may not withhold our approval of the arrangement because the pattern for the proposed rates is the existing adjustment made by the respondents motor carriers instead of the all-rail adjustment." It was further held by the majority that it could not condemn the plan of joint operation merely because experience may demonstrate that certain phases of that operation are not profitable. It was pointed out, however, that the finding should not be construed as approving the operation of the motor carriers over the routes involved.

In addition to holding that the plan would bring about larger revenues on less-than-carload shipments for the Chicago Great Western the majority said it would also be of service to shippers and the general public.

Dissenting, Commissioners Porter and McManamy held that the plan would not be in the public interest because its ultimate result would be merely an increased profit to the motor carrier. They also contended that the proposal was in reality not a joint tariff since the shipment is under control of the motor carrier only and that it might result in discrimination between the all-rail shipper and the shipper taking advantage of the new arrangement.

Othmar I. Larsen

Othmar I. Larsen, 53, assistant to the president of Borg-Warner Corp. and formerly president of the Marvel-Schebler Carburetor division of Borg-Warner, died Monday, Nov. 23, at the Highland Park Hospital, Highland Park, Ill., following a brief illness which followed an operation for appendicitis. Burial services were at Wilmette, Ill., Nov. 25. Surviving are the widow, Louise, and one daughter, Olga, both of Wilmette, and two sons, Thomas, of Flint, Mich., and Leonard, of Wilmette.

Mr. Larsen was a native of Oslo, Norway, but had spent most of his life in this country where he was identified with the automotive industry.

Court Denies ATA Plea Against Rail Pick-Up, Delivery Service

The District of Columbia Federal Court, Nov. 24, denied the petition of the American Trucking Associations, Inc., for an interlocutory injunction to stop the pick-up and delivery service begun two weeks ago by the railroads upon the authority of the Interstate Commerce Commission. The ATA contended that the commission was without authority to permit the service. It also maintained that the five cents per 100-lb. rebate offered by the railroads to consignors and consignees who would pick up and deliver shipments at the rail head was a violation of law.

The court held that the case involved a rate making matter that comes under the jurisdiction of the commission and that it would not interfere with that jurisdiction.

The ATA will appeal the case to the United States Supreme Court.

JAMES D. MOONEY, GM vice-president in charge of overseas operations, has been elected to the governing council of New York University, according to an announcement by Dr. Fred I. Kent, president of the council.

JOSEPH GESCHELIN, Detroit technical editor of AUTOMOTIVE INDUSTRIES will address a meeting of the Rockford Associates at Rockford, Ill., Dec. 14. The talk will deal in general with the future trend in automotive product design as well as the changing picture in manufacturing techniques and production equipment.

LEONARD T. DALECKE, assistant resident manager of Fisher Body Unit No. 1 at Flint, Mich., has been promoted resident manager of the Fisher division at Atlanta, Ga. His successor in Flint has not yet been named.

STEPHEN J. KAISER, master mechanic at the Chevrolet plant and president of the IMA, has been appointed master mechanic of the Adam Opel, A. G., division of General Motors in Resselsheim, Germany.

G. W. STALLINGS, formerly of Jackson, Mich., has been appointed accessory sales manager of the Yale & Towne Mfg. Co., Detroit division.

GRANT GOODWIN, formerly metallurgist of the Muehlhausen Spring Co., is now associated with the Lindberg Engineering Co. as district manager of the Indiana and Southern Illinois territory, with offices in the Illinois Building, Indianapolis.

A. R. (ART) FORS, who was on the Chrysler central estimating department staff for the last three years, has been transferred to the new Dayton plant. On his new assignment, Mr. Fors will serve in the capacity of works manager of Airtemp, Inc., division of Chrysler Motors Corp. Prior to his connection with Chrysler, Mr. Fors was works manager for Continental Motors Corp.

E. J. HUNT, master mechanic of the Plymouth Motor division of Chrysler Corp., has been transferred to the central estimating department of Chrysler Corp. Ed Hunt has been connected with the corporation continuously since the days of the old Maxwell car some 20 years ago.

"Mighty Sweet" is the label a hat manufacturer puts in his latest model, patterned after the one worn by the Studebaker girl.

Business in Brief

Written by the Guaranty Trust Co., New York, exclusively for AUTOMOTIVE INDUSTRIES

There was no interruption of the upward movement of general business activity last week. The weekly business index compiled by the *Journal of Commerce* stood at 99.8, as against 99.0 the week before and 84.0 for the corresponding week last year. Merchants are looking forward to heavy Christmas business. Retail trade was estimated from 15 to 22 per cent above that in the corresponding period last year, while wholesale business gained from 20 to 25 per cent.

Carloadings Higher

Railway freight loadings during the week ended Nov. 14 amounted to 784,672 cars, which marks an increase of 25,354 cars above those in the preceding week, a gain of 154,944 cars above those a year ago, and a rise of 199,638 cars above those two years ago.

Sharp Gains for Chain Stores

Sales of 29 store chains, including two mail order houses, during October were 18.4 per cent above those in the corresponding period last year. Sales of these same companies during the first 10 months of this year were 13.6 per cent above those a year ago.

Home Building Up 45%

Residential construction contracts awarded in 37 eastern states during October, according to the F. W. Dodge Corp., were 45 per cent above those in the corresponding period last year. Residential contracts awarded in the first 10 months of this year were 70 per cent above those a year ago.

Lumber Production Off

Lumber production during the week ended Nov. 7 was 57 per cent of the 1929 weekly average. The decline in output is only partly seasonal and is largely due to the retardation of the lumber movement attending the maritime strike. Production was 18 per cent below that in the preceding week; shipments showed a decline of 27 per cent, and new orders were 25 per cent smaller.

Fisher's Index

Professor Fisher's index of wholesale commodity prices for the week ended Nov. 21 stood at 86.1, a new high for this year, as against 85.3 the week before and 84.7 two weeks before.

Federal Reserve Statement

The consolidated statement of the Federal Reserve banks for the week ended Nov. 18 showed a decline of $2,000,000 in holdings of discounted bills. Holdings of bills bought in the open market and government securities remained unchanged. Money in circulation declined $18,000,000, and the monetary gold stock increased $22,000,000.

Notes from Nippon

Toyoda-Mitsui Merger Likely; Machine Orders for U. S.

Toyoda Automatic Loom Co., builder of the first American-type car in Japan, has decided to produce a larger portion of the parts going into its cars and is building a new plant with a capacity of 6000 passenger cars per year. It is reported that Toyoda has decided to cooperate further with the far-reaching Mitsui interests, which already have an exclusive export contract. A new company, capitalized at 20,000,000 yen ($6,000,000), is proposed, with half the capital to be paid in at once, and Mitsui to take a 50 per cent interest. It has been decided to change the name of the company to "Toyota."

An experiment in the use of natural gas for fueling buses has been made by the Keisei Electric Railway Co., cooperating with the Riken Piston Ring Co., which remodeled the engine for this purpose. The bus was built on a 1929 four-cylinder Ford truck chassis. Five steel tanks having a combined capacity of 7000 litres were fitted to the rear of the chassis, the total weight of the installation being 440 lb. The natural gas was compressed to 200 atmospheres and the fuel was supplied to the engines at from 50 to 80 atmospheres pressure. Tests indicated that the fuel cost per mile was about 12 per cent of the cost when gasoline was used. Speed was almost equal to that of the gasoline burning vehicle and starting was easier, it is said. Natural gas is abundant in Japan but has heretofore been used only for producing carbon black.

The Nissan Automobile Co. is reported about to spend 5,000,000 yen ($1,500,000) for new machinery, all of which will go to United States machine tool manufacturers, it is said.

A new company has been formed to make spark plugs for both automobiles and airplanes. It is the Nihon Gaishi (Japan Insulator) Co., and is capitalized at 1,000,000 yen.

Commercial Credit to Pay Extra Dividend and Bonus

At a special meeting of the board of directors of the Commercial Credit Co. the quarterly dividend of $1.00 per share and an extra or special dividend of $2.00 per share were declared on the common stock, and the regular quarterly dividend of $1.06¼ per share was declared on the 4¼ per cent cumulative convertible preferred stock. All are payable Dec. 15, 1936, to holders of stock of record Nov. 30, 1936.

Desiring to substantially recognize the efforts of the officers and employes of the corporation and its subsidiaries, a special compensation of one month's salary was declared, payable Dec. 15, 1936, to such officers and employes who are on Dec. 1, 1936, and who were prior to Jan. 1, 1936, on the payroll of the corporation or of any of its now existing subsidiaries. A special compensation of one-half of one month's salary was declared for all other employes who are on the payroll Dec. 1, 1936. This special compensation to all officers and employes is in addition to the five per cent special compensation paid June 30, 1936, to those employes whose annual salaries were not more than $10,000 and who were on the payroll prior to July 1, 1935, making a total of more than $550,000 for the year. In addition, current salaries have generally been readjusted upward during the current year and this policy will be continued.

"Diesel Day" Luncheon

The 40th anniversary of the introduction of Diesel power into the United States will be observed Dec. 2 by a group of 300 leaders in business, industry and engineering, at a luncheon at the Waldorf-Astoria, in New York, arranged by the Diesel committee of the Exposition of Power and Mechanical Engineering. The date coincides with "Diesel Day" at the Power Show scheduled to open in New York, Nov. 30.

40 Years Ago

with the ancestors of AUTOMOTIVE INDUSTRIES

The New Motor Law in England

The most important event of the month was the going into effect in England, on Nov. 14, of the new Act of Parliament legalizing the use of motor vehicles on the common roads of that country. . . . The key to the regulations is that: "He shall not drive the light locomotive at any speed that is greater than reasonable." . . . London *Engineering* does not take this view of the situation. Its peace is disturbed by visions of slaugtered pedestrians and shattered vehicles because of the latitude the Board has given as regards the speed at which a motor vehicle may be driven. . . . "A heavy vehicle weighing several tons," says *Engineering*, "would not be likely to do any harm at 7 m.p.h., but at 14 m.p.h. it would become a fearful menace to life and limb." This is undoubtedly true, but it is pertinent to ask the question, who, with the exception of the editor of *Engineering*, imagines that anybody will be guilty of such madness as to run a heavy vehicle at such speed?

—From *The Horseless Age*, November, 1896.

"Marks Bond," New Sheet Metal Coating, Announced

A new chemical coating for sheet metal parts which is said to prevent corrosion and to produce a good paint-adherent surface has been announced by the Bonding Process Co., Detroit. The process is recommended for all types of sheet metal elements including fenders, splashers, and complete steel bodies.

The coating process is known as the "Marks Bond" which is claimed to be protected by broad patents. It is claimed that only 15 to 30 seconds at a temperature of 160 deg. to 180 deg. F., is required in the spray system or dip tanks, depending upon the speed of a production line. The articles to be bonded are usually prepared by chemical cleaning.

The "Marks Bond" chemical is a concentrated compound which, when dissolved in water at a specified temperature, forms a solution which reacts immediately on properly cleaned metals. The coating is velvety-opaque, gray in color. Among other features claimed for this process is the virtual disappearance of sludge in dip tanks.

It is claimed that the process is capable of producing appreciable savings in time, fuel cost, material cost, and space required for equipment. Figures provided by the company, based upon tests conducted by a number of manufacturers in the automotive industry, indicate that on the average test panels coated by this process and finish-painted have withstood over 500 hours exposure in the salt spray cabinet.

German Visitors to ASI Show

L. Fenyves-Friedmann, managing director, and K. Nemetz, chief engineer, of Defag, Berlin, automotive parts manufacturing company, will visit New York and Chicago at the time of the ASI show. In New York they will make their headquarters at the Commodore Hotel and in Chicago will be at the Bismarck Hotel.

Globe photo

The Czechoslovakian Tatra shown recently at the Prague automobile show goes in for ultra-streamlining

ASME Annual Meeting

The annual meeting of the American Society of Mechanical Engineers will be held in New York next week, Nov. 30 to Dec. 5. A number of papers of interest to the automotive industry will be presented at the sessions of Dec. 1 and 2, and at the aviation meeting Dec. 4.

Service Show for Minneapolis

The first annual Northwest Automotive Maintenance Show will be held in the Minneapolis Auditorium, April 8 to 11 inclusive, and will be sponsored by the Automotive Boosters Club, Northwest No. 8, of Minneapolis.

British Ford Plant Expanded, Employment Increased by 20%

Important additions to the production facilities of the British Ford plant at Dagenham, near London, have been in progress during the last few months, and are now completed.

In the engineering shops, devoted to foundry, manufacturing, and assembly, 120,000 sq. ft. of floor space has been added by the erection of balconies, increasing the capacity by 11 per cent. These shops are now believed to comprise the largest building under one roof in Britain.

During the last few months there has been a 20 per cent increase in the number of employes, the introduction of the new 22 hp. V-8, a Dagenham product throughout, having accelerated the need for expansion.

The whole of the tool-room has been transferred to the balconies, while the tool stores, miscellaneous steel stores, and service stores are also now situated overhead. Engine reconditioning under the company's engine exchange plan is carried out in this section of the shops while works canteens also occupy considerable space.

Wage distribution has been simplified by making every day a pay-day. Employes are divided into 10 groups, each having a different pay period, and therefore a different pay day. It has been found that the men quickly accustom themselves to the somewhat unusual method, which has the further advantage of ensuring a more even circulation of money in the neighborhood of the factory. British Ford employes have a five-day week of 40 hours.

A. L. Hayes

A. L. Hayes, an executive of the White Motor Co. for nearly 30 years prior to his retirement in 1929, died in Cleveland Nov. 19. He was assistant in charge of sales for a number of years and in 1926 was promoted assistant to the vice-president.

Calendar of Coming Events

SHOWS

Baltimore Automobile Show.Nov 26-Dec. 5
28th Automobile Salon, Brussels, Belgium .....Nov. 28-Dec. 9
Peoria Automobile Show..Nov. 30-Dec. 5
Natl. Exposition of Power & Mechanical Engineering, Biennial Meeting, New York City .....Nov. 30-Dec. 5
First International Consumers Petroleum Exposition, Convention Hall, Detroit .....Dec. 5-13
Automotive Service Industries Joint Show, Chicago .....Dec. 9-13
National Motor Boat Show, New York, Jan. 8-16
Illinois Automotive Ass'n, 4th Annual Show and Maintenance Exhibit, Navy Pier, Chicago.....Apr. 24-28, 1937

CONVENTIONS AND MEETINGS

American Society of Mechanical Engineers, Annual Meeting, New York, Nov. 30-Dec. 1
Motor & Equipment Wholesalers Assn., Annual Convention, Chicago ..Dec. 7-8
National Automotive Parts Assn., Annual Convention, Chicago .....Dec. 7-8
National Standard Parts Association, Annual Convention, Chicago...Dec. 7-8
Motor & Equipment Mfrs. Assn., Annual Meeting, Chicago .....Dec. 10
Tin Can Tourists' Homecoming, Arcadia, Fla. ....Dec. 28, 1936-Jan. 3, 1937
S.A.E. Annual Meeting, Detroit, Mich., Jan. 11-15, 1937
Tin Can Tourists' Winter Convention, Clearwater, Fla.....Jan. 29-Feb. 8, 1937
Tin Can Tourists' Winter Convention, Sarasota, Fla. .....Feb. 8-14, 1937
International Association for Testing Materials, Second International Congress, London, England, April 19-24, 1937
41st Annual Convention and Exposition of the American Foundrymen's Association, Milwaukee, beginning May 2, 1937
American Petroleum Institute, Mid-Year Meeting, Colorado Springs, Col. .....June 1-3

Automotive Metal Markets

Sheet Steels Advance $2 to $4 per Ton Foreshadowing General Mark-Up Next Year as Result of Wage Increases

By William Crawford Hirsch

Announcement of advances early this week by one of the leading steel producer's subsidiaries, ranging from $2 a gross ton in the price of semi-finished material to $4 a net ton in that for sheets, ended uncertainty regarding the steel market's price structure during the first quarter of next year. A mark-up in prices all along the line had become a certainty when higher wage scales in the steel mills became effective a week ago.

Under the new price set-up, the buyer of body stock still fares considerably better than he did in 1929, while the quantity buyer of carbon bars, which have been marked up $3 a ton, pays slightly more than he did in 1929. The new $34 price for sheet bars is somewhat lower than the 1929 price, but a shade higher than the 1930 average. In other words, with the exception of flat steel prices, the market is very much like that of 1929.

Advances were also announced in prices for tool steels, effective Jan. 1. High-speed tool steels have been raised from a base of 57½c. per lb. to 60c., and hot-worked tool steels from 44c. to 46c., with carbon tool steels lifted from 19c. to 20c. per lb. Recent retooling in automobile plants has called for extraordinarily large tonnages of tool steel and the momentum of demand is still apparent.

Under the spur of first quarter price advances, buyers added considerable tonnage to their previous commitments for sheets and strip steel this week at old prices. Under prevailing conditions producers are quite likely to be reluctant to book fourth-quarter business after Nov. 30. Unfilled orders of the members of the National Association of Flat Rolled Steel Manufacturers on Nov. 1 were equal to 98.7 per cent of their sheet capacity, so that a sold-out condition is certain to face buyers who seek to place orders at old prices in December.

Pig Iron—No. 2 foundry iron was advanced $1 a ton in the Chicago market on Monday, the higher price of $20.50 a ton, delivered becoming immediately effective. Buffalo district furnaces also marked their prices up $1. Automotive foundries are largely covered for their fourth quarter needs.

Aluminum—Firm and quotably unchanged. The undertone of the market for secondary aluminum and alloys is stronger.

Copper—Aside from good support of the market by domestic consumers, sales recorded this month so far being between 85,000 and 90,000 tons, the influence of the export price, which is about ¼ cent above that of the domestic quotation, is unmistakable. Brass and bronze fabricators report steadily increasing demand. Electrolytic copper continues to be quoted at 10½ cents, delivered Connecticut.

Tin—Latest information regarding the activities of the International Tin Committee indicates a program of better alignment of production and demand, with the maximum of restriction of the former somewhat more limited than heretofore and all producing countries participating in a new agreement. At the beginning of the week the price of spot Straits tin had receded to 51 cents, compared with 51⅛ cents at the preceding week's close and 53¼ cents on Nov. 13.

Lead—Latest statistics of the lead industry disclose increased shipments and a sharp reduction in refinery stocks. Storage battery manufacturers have been buying heavily. Market strong.

Zinc—Quiet and steady.

1½ to 12-Ton Trucks in New GMC Cab-Over-Engine Models

A completely new line of GMC trucks soon will be introduced, according to J. P. Little, vice-president directing sales.

The line will comprise an array of cab-over-engine trucks ranging in capacity from 1½ to 12 tons and including the lowest priced 1½-ton model of this type now offered. The line of standard GMCs, also entirely new, has been augmented by the addition of a 112-in. wheelbase ½-ton unit which supplements the 126-in. wheelbase model already included in the line. It will be priced at $395, chassis f.o.b. Pontiac, the lowest price ever placed on a GMC truck.

Both types of trucks are available with pickup or panel bodies of bigger than average size. The longer wheelbase chassis will accommodate a panel body 8 ft. 5 in. long or a pickup body 7 ft. 7 in. long. In the 1½ to 2-ton range, there is a GMC truck with many advanced features of design and construction priced at $525 chassis f.o.b. Pontiac.

Strike Effects Confined

(Continued from page 731)

throughout the country than were sold at the same shows last year," declares D. E. Ralston, Oldsmobile's vice-president and general sales manager. The greatest sales increase noted so far is in Toledo where 313 per cent more Oldsmobiles were sold than during the show period a year ago. In Detroit, sales jumped 216 per cent. Sales increases in other leading show cities are: Chicago, 183 per cent; Boston, 145 per cent; New York, 77 per cent; Cincinnati, 77 per cent, and Philadelphia, 36 per cent.

Oldsmobile's factories are now turning out more than 1000 cars daily. It is expected that more than 25,000 cars will be built and shipped from Lansing during the month of December with still larger schedules laid down for the following months.

Retail sales of Hudsons and Terraplanes in the United States for the week ending Nov. 14, totaled 1820 cars, according to figures announced by W. R. Tracy, vice-president in charge of sales. This exceeds the figure for the corresponding week of 1935 by 28 per cent, and is a gain of 29 per cent over the preceding week this year. Late fall and early winter business is expected to rank among the best in the history of the company from a sales standpoint.

Preliminary operations on the new Willys-Overland line have started, but full speed is not expected until next week.

Ford of Canada to Spend $1,700,000 on Expansion

Confident that its market not only in Canada but also throughout Empire territories overseas will increase substantially during the next few years, Ford Motor Co. of Canada, is preparing to spend $1,700,000 in expansion and modernization of its manufacturing facilities in Windsor, Wallace R. Campbell, president, has announced.

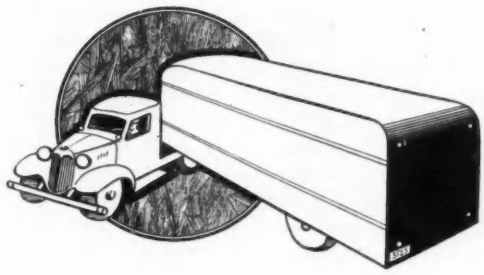
The project will involve enlargement of the main manufacturing plant at a cost of some $300,000 and installation of $1,400,000 in new machinery to provide improved and modernized manufacturing facilities. Mr. Campbell said that construction work on the plant addition will begin as soon as engineering preliminaries can be completed, probably about Jan. 1. The enlarged plant should be in full operation within a year.

The new section will provide 73,000 sq. ft. of additional floor space and permit rearrangement of manufacturing facilities in the plant, and installation of additional equipment. The additional space will also permit removal of some operations from the river front plant. These will include radiator parts manufacture and assembly and gas tank manufacture.

Libbey-Owens' $100 Bonus

Libbey-Owens-Ford Glass Co. directors voted a bonus of $750,000 to employes. Each worker on the payroll throughout 1936 will receive $100 of which half will be paid Dec. 15 and the remainder when he takes his 1937 week's vacation with pay.

Chrysler Motors Parts Corp. has leased the building shown above from the Fairfax Industrial District in Kansas City, Mo.



"Jack-knifing"

in the operation of tractor-trailer combinations analyzed — its causes and suggested cures

By P. M. Heldt

MOST operators of tractor-trailer combinations probably have had experience with the phenomenon of "jack-knifing," which is the equivalent in tractor-trailer operation of the common side skid in the operation of single vehicles. The tractor skids around in one direction and the trailer at the same time skids in the opposite direction, until it ends up against the cab or some other projecting part of the tractor. Jack-knifing naturally results from instability of the tractor-trailer train in motion, and it should therefore be of interest to investigate the conditions of stability of such trains under different operating conditions.

In Fig. 1 is shown a plan-view diagram of such a train. The propelling force originates at the driving wheels of the tractor (which is assumed to be of the two-wheel-drive type). Since the differential gear always divides the torque equally between the wheels on opposite sides, the driving forces due to both wheels are equal, and their resultant lies in the longitudinal axis of the vehicle. In the diagram this driving force is represented by the arrow A.

The driving force is equal and opposite in direction to the resistance to motion. On level ground and at constant speed this is made up of the rolling resistance and the air resistance. In the diagram the resistances are represented by the arrows B. The rolling resistance is encountered at the points of ground contact of the wheels, and the resistance at each wheel is substantially proportional to the load on that wheel. Normally both the air resistance and the rolling resistance are symmetrically distributed with respect to the longitudinal axis of the car, and the equivalent total resistance therefore acts in the longitudinal vertical center plane. However, it is quite conceivable that the resistance encountered by a wheel on one side of the train is not exactly equal to the resistance to motion of the corresponding wheel on the opposite side. For instance, the load may not be symmetrically distributed with respect to the longitudinal axis of the train, or one set of wheels may be traveling on a soft shoulder while the other set are on smooth, hard pavement. In that case the equivalent resistance will not be in the axis of the vehicle, but to one side of same, and the propelling force and resistance then form a couple which tends to deflect the tractor from its course. However, if the steering gear is held in the central position, deflection from the straight-ahead course could occur only as a result of sideward slip of the wheels, and this is resisted by the adherence between tire tread and pavement, which on ordinary hard pavements is of the order of 60 per cent of the gross load on the wheels. The rolling resistance, on the other hand, is only about 2 per cent of the load on the wheels. Therefore, to overcome the resistance to lateral sliding of the tires on the hard pavement requires a force which is some 30 times as great as the force required to move the vehicle or train in the direction of travel, and any slight lateral shift of the center of resistance, due to road inequalities, etc., is entirely insufficient to affect the stability of the vehicle or train.

JACK-KNIFING naturally results from the instability of the tractor-trailer train in motion, and in this article P. M. Heldt digs down to the root of the causes under different operating conditions.

A trailer is naturally stable while it is being drawn by the tractor. This can be seen by reference to Fig. 1, where C represents the forward pull exerted by the tractor on the trailer through the coupling pin and B the resistance to motion encountered by each of the two trailer wheels, the resultant of these two resistances being represented by D. Whenever the trailer is accidentally thrown out of alignment with the tractor, or, rather, with the direction of the pull on the coupling pin, this pull and the resistance D form a couple which has a tendency to restore the trailer to its normal position, in line with the direction of motion of the

tractor. For this reason the trailer is said to be in stable equilibrium.

If the trailer is accidentally thrown out of line with the tractor, it can be brought back into line by a suitable operation of the steering gear, but usually the driver will not notice any slight deviation of the trailer, and alignment then will have to be restored automatically, which is possible only through sideward slipping of the trailer wheels, the tractor wheels, or both. This sideward slip naturally is accompanied by a much greater forward rolling motion, so what actually occurs is a gradual creep back into alignment.

It is a general principle of stability of motion that if the point of application of the driving force or propelling force is located ahead of the point or points where the resistance to motion is encountered, the motion is stable, or the moving body is in stable equilibrium. In the opposite case, when the point of application of the driving force is located behind the point or points where the resistance to motion is encountered, then the motion is inherently unstable, unless the moving body or vehicle is positively guided. For instance, in the case of a train of railroad cars on a track it makes little difference whether motion is produced by a locomotive at the head or at the rear end of the train, as the cars cannot leave the track.

A motor vehicle, while not guided as positively as a rail vehicle, is guided by the comparatively high resistance to transverse sliding motion of its wheels on the pavement. As the resistance to rolling motion is only about one-thirtieth that to sliding motion, a force many times that needed to keep the vehicle rolling is required to set it sliding or skidding sideways.

As a rule, wheeled vehicles show evidences of instability in motion only when the brakes are applied so hard that the wheels are locked or nearly locked. There does not seem to be nearly as much trouble from skidding of passenger cars today as there was in the earlier years, when two-wheel brakes were the rule. The wheels naturally are much more easily locked when the whole of the driver's effort is applied to brakes on two wheels. Of course, there have been other developments also which may account for the relative immunity from skidding in modern motoring. For one thing, we have a much greater proportion of concrete roads, with a relatively high coefficient of adhesion. Besides, motorists have learned better to guard against skids and to correct for them in their incipient stages. The usual cause of a severe side skid is locking of the driving wheels by the brakes. When the wheels are locked they lose all directing tendency. A locked wheel can only slide, and it can slide sideways about as easily as forward. The resistance to motion of the wheel is greatly increased when it is locked, but the force necessary to move it is supplied by the inertia of the moving vehicle, which will produce whatever force is necessary to overcome the resistance, until the store of kinetic energy has been exhausted.

A tractor-trailer train consists of two units which are connected together by a coupling pin or its equivalent. Brakes may be applied either to the tractor alone or to both the tractor and trailer. In mosts of the states trailer brakes are now compulsory, at least if the load capacity is beyond a certain, quite low limit. As long as driving power is being developed, the tractor naturally pulls on the coupling pin. If brakes were applied to the wheels of the trailer alone, then the tractor would continue to exert a pull on the coupling pin, and through it on the trailer, even with the power shut off, and it can easily be shown that under this condition no skidding or jackknifing can occur. (Fig. 2) With a pull being exerted on the forward end of the trailer and the principal resistances acting on its wheels, near the rear end, the trailer naturally will stick to its straight-ahead course, even if its wheels are locked. As no braking is done on the driving wheels of the tractor, these will rotate freely and therefore will have a powerful directing tendency. Even if the tractor should be slightly deflected from its course, the drag of the trailer would immediately straighten it out again.

However, tractor-trailer trains in which brakes are applied to the trailer wheels only are not in practical use, and this case therefore is of theoretical interest only. With the trailer unloaded, the braking effect obtainable from the trailer wheels alone would be quite inadequate for safety at the higher speeds usually maintained when traveling light.

Brakes on Tractor Only

Let us next consider the case of a train in which brakes are applied to

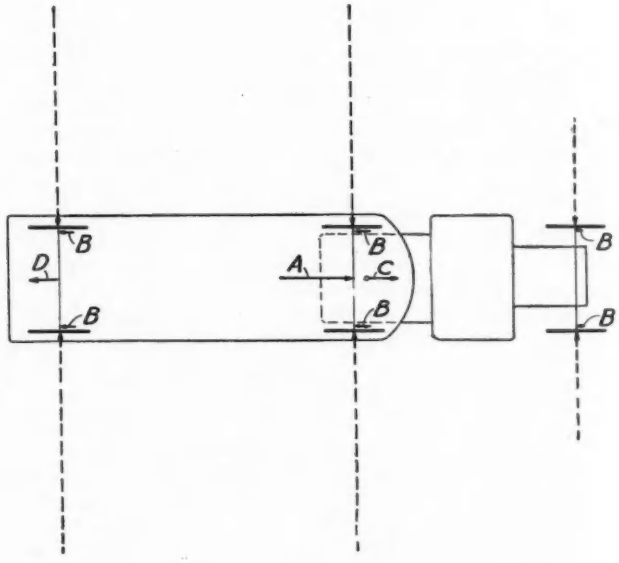


Fig. 1—Forces on tractor and trailer when traveling under power (trailer in stable equilibrium.)

A, propulsive force produced by tractor drive wheels; B,B,B, B,B,B, rolling resistances of wheels; C, pull of tractor on coupling pin and trailer; D, equivalent rolling resistance of two trailer wheels. The transverse dotted arrows indicate the frictional forces which would have to be overcome to cause the wheels to skid. Each of the arrows represents the resistance to skidding of one wheel only, and as the two wheels on each axle must of necessity skid together, the actual resistance to skidding at any particular point is proportional to twice the length of the arrow at that point.

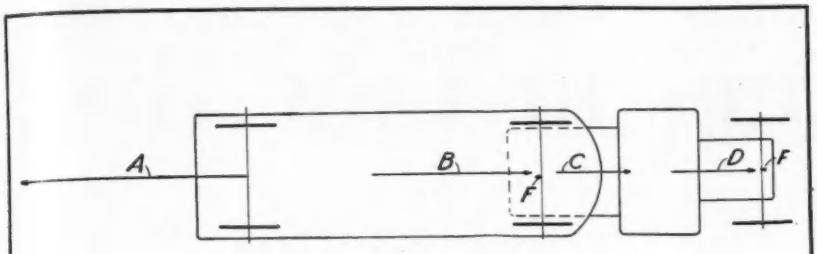


Fig. 2—Forces on trailer when decelerated by trailer brakes (stable equilibrium)

A, retarding force due to trailer brake; B, inertia force due to trailer weight; C, pull of tractor on coupling pin; D, inertia force due to inertia of tractor weight. A = B + C.

the wheels of the tractor only. This is undoubtedly the case in which the risk of jack-knifing is greatest. In the first place, as only little more than one-half of the total weight is available for braking purposes (considering the trailer to be loaded), for a stop in a reasonable distance the brakes on the tractor wheels must be applied quite hard. Should the driving wheels be locked, the stability of tractor motion would at once be endangered. (Fig. 3) The forces which keep the train in motion now act at the centers of gravity of the tractor and trailer, respectively, and if the coupling pin axis moves even slightly from the line connecting the two centers of gravity, a jack-knifing effect is produced, in that both units tend to pivot around their forward ends, in opposite directions, the turning moment on both increasing with the angle between their axes.

The only precaution which can be taken against jack-knifing in the case under consideration is to try to prevent the possibility of locking the driving wheels. This is not easily done, however, as the weight of the whole combination must be stopped by the braking effect exerted on the tractor wheels, and the tractor therefore must have powerful brakes. It is well to keep in mind in this connection that when brakes are applied to the wheels of the tractor only, while weight is virtually transferred from the tractor rear to the tractor front wheels, there is no such transfer of weight from the trailer wheels to the tractor rear wheels. The best division of braking effect between tractor rear wheels and tractor front wheels is undoubtedly that of the effective loads on the rear and front tires, respectively, when the brakes are fully set. About the only other thing that can be done is to use tires with good non-skid treads. There are, of course, types of brakes which will prevent locking of the wheels under all conditions, but these have never come into practical use.

Finally, we come to the case of greatest importance, that in which there are brakes on both the tractor and trailer wheels. In this case the relative timing of brake application on the two units is of importance. Skidding and jack-knifing are likely to be initiated the moment the brakes go on, rather than after they have been effective for some time, when the speed has been considerably reduced in consequence. If the tractor brakes become effective first, the effect for a short period of time is the same as with brakes on the tractor only; the rear wheels of the tractor are then easily locked and jack-knifing may result. If the reverse condition can be brought about and the trailer brakes applied first, the danger of jack-knifing is evidently greatly reduced, if not entirely eliminated.

Relative Power of Tractor and Trailer Brakes

Aside from the timing of beginning of brake action on the two units, the effect produced depends largely on the retarding force exerted on each unit by its own brakes, relative to the total weight of the unit. As both units are mechanically coupled together, they naturally will be decelerated at the same rate. The rate of deceleration varies directly as the ratio of the retarding force to the weight or mass retarded, and this ratio will not be the same for both units. In fact, it will generally be much greater for the tractor. This is due to the fact that the maximum retarding effect which it is possible to produce by the tractor wheels is proportional to the weight on these wheels, which includes not only all of the tractor weight but also nearly one-half of the trailer weight. On the other hand, the weight on the trailer wheels is only little more than one-half of the trailer weight, and the retarding force which it is possible to obtain by means of the trailer wheels is limited accordingly.

If the ratio of the retarding force exerted by the trailer wheels to the weight of the loaded trailer were greater than the ratio of the retarding force of the tractor wheels to the weight of the tractor, then the tractor would exert a pull on the coupling pin of the trailer during the braking period, and the conditions would favor stability. There would then be no tendency for the trailer to pirouette around the coupling pin, even if the tractor wheels were locked by the brakes, and the drag of the trailer on the coupling pin would tend to hold the tractor to a straight course. Unfortunately, this relationship is difficult to obtain, because the trailer brakes can utilize only about half the trailer weight for adhesion, whereas the tractor brakes can make use of perhaps twice the tractor weight for the same purpose. It is obvious, however, that the more effective the trailer brakes can be made the greater the assurance

(Turn to page 759, please)

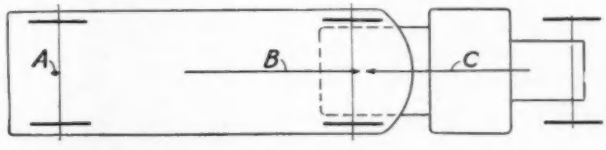


Fig. 3—Forces on trailer when tractor brakes are applied (unstable equilibrium)

A, rolling resistance of trailer wheels; B, inerta force due to trailer weight; C, backward push of tractor on coupling pin. B = A + C.

Rear Engines at Low Risk

Automobile bodies designed along present lines could be adapted to front or rear engined cars, with salvaging of die costs if rear engine design didn't "take"

By Athel F. Denham

WE believe it was "Bill' Stout who made the remark a couple of years ago that "you can't move the engine to the rear of an automobile gradually." Yet, one of these days we are going to have rear-engined cars with us.

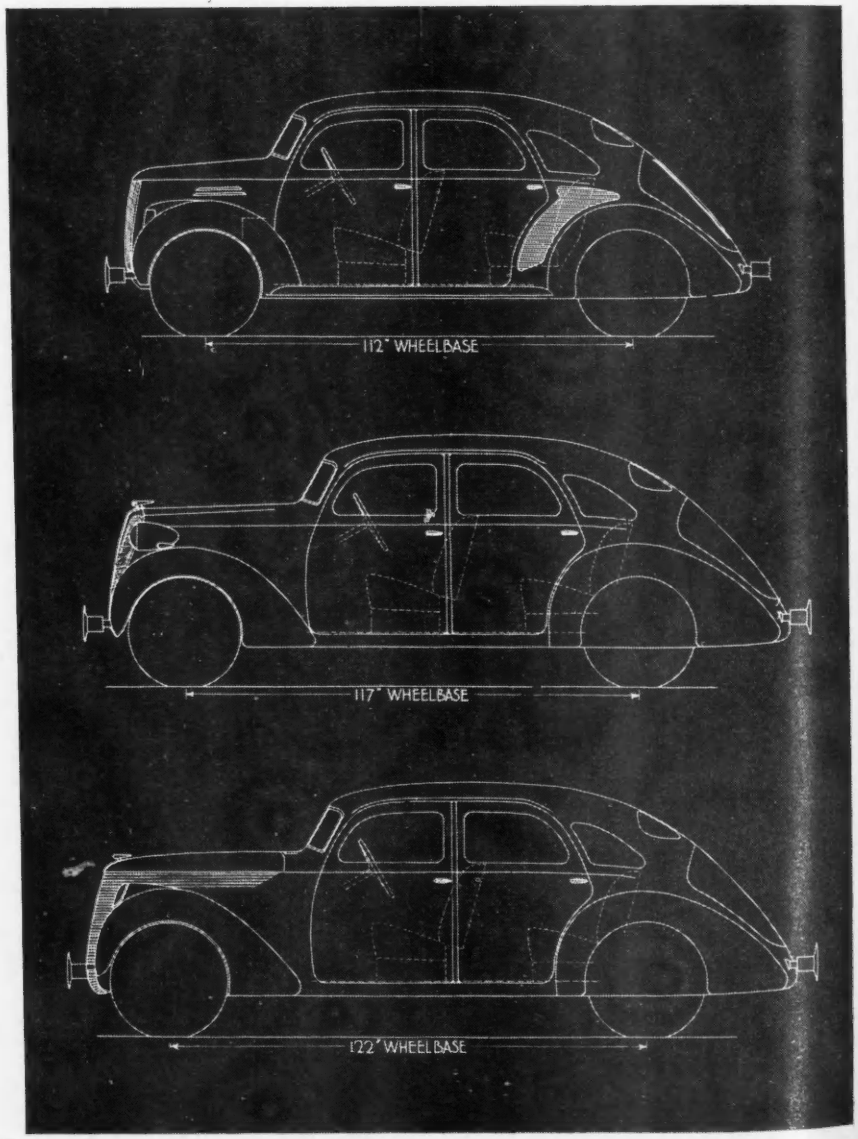
Engineering thought has been changing—it is now being realized that while the engine—as a physical unit—cannot be moved gradually to the rear of the car, it is possible to move it back when nobody is looking.

Imagine your surprise if you should open the luggage compartment door some Christmas morning and find a complete power plant taking up all the room. Puzzled, you walk around to the front to see what has happened and under the hood you discover the missing spare tire and lots of room for suitcases, ginger ale bottles, and the rest of your traveling equipment.

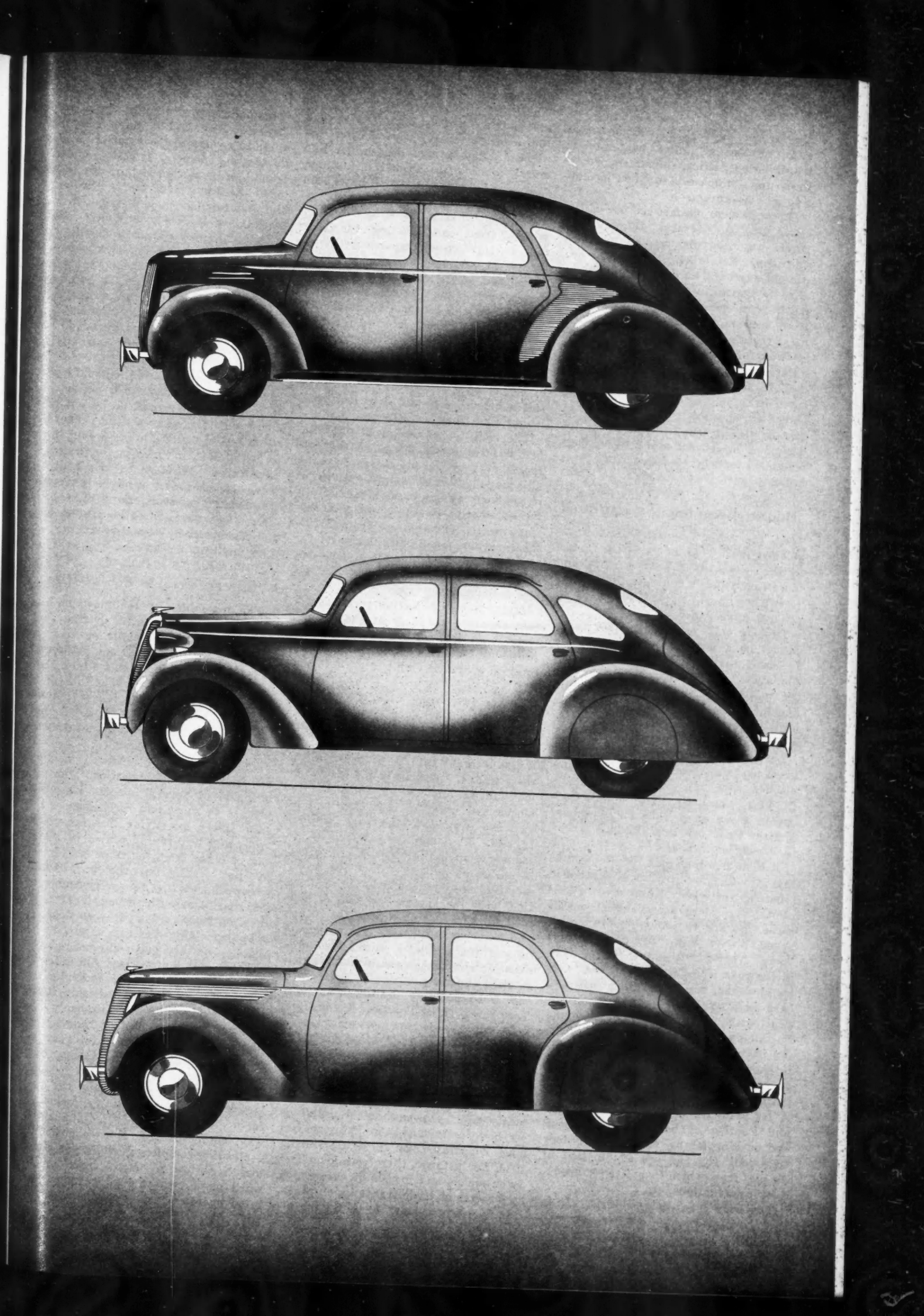
Seriously, the industry has already begun "gradually to move the engine to the rear." With our bigger rear trunk and luggage compartments there is already almost room enough back of the rear seat in some cars to accommodate a reasonably sized complete powerplant.

Now about all that is necessary, some engineers feel, is for some manufacturer to sit down and so plan his next year's models that if he wants to he can switch engines in mid-stream, as a matter of routine, without danger of drowning in body die costs.

Die costs for bodies and sheet metal represent the biggest annual expenditure every automobile manufacturer has had to worry about. In the big companies considerable savings are accomplished by stamping body panels, doors, etc., for several lines of cars from the same dies. Among the smaller independents some efforts have been made toward cooperative action between different car manufacturers on body dies, just as for years the industry has already cooperated in using identical or



Bodies for all three cars are made from the same dies. Above is a rear-engine six, in the middle a front engine six and below a front engine eight. How individuality may be obtained is suggested by the different hood treatments. Also, note the much shorter overall length of the rear engine car although it has the same body room as the other two designs.



similar tooling for the production of such mechanical units as clutches, transmissions, axles, universals, etc.—those units which are supplied by outside manufacturers.

One argument against the use of the same dies for several different car makes has been the demand for individuality. Yet when we analyze our present-day cars we find that individuality in appearance does not come so much from general design as it does from such minor variations as moldings, reveals, etc. All of these can be allowed for in die-making so that for different makes or different cars the desired modifications can be incorporated in the die assembly without difficulty. In addition, "individuality" today is also largely influenced by the design of hoods, radiator grilles, body moldings, fenders, etc., as distinct from bodies proper.

Bodies Becoming Standardized

As the modern automobile has developed from year to year, car bodies in themselves have become more and more functional in character and therefore more and more standardized in general appearance.

That is only reasonable since there cannot be a wide variety of ideal car bodies if they are all supposed to do the same thing: accommodate five or six passengers with the maximum amount of comfort, and safety. Everybody is just getting closer and closer to that ideal.

Let's just go a step further. On these pages are sketches of three automobiles. One is a straight eight, on a 122-inch wheelbase. The middle-sized one is a six on a 117-inch wheelbase and the third one is a 112-inch wheelbase rear-engined six.

The interesting part of it is that they are designed so that all are made from the same body, from cowl to taillight. The doors are identical on all three. So are the cowls, roofs, windshield pillars and rear compartment doors. There is a slight change only in the rear wheel housing of the rear-engined car due to shifting the axle back slightly. Tail stampings are identical with the exception of a grille in the door of the rear-engined car. No particular attempt has been made to show just HOW different they can be made to look. The front ends are patterned on standard practice today. A lot more could be done with shape and location of body moldings, head and parking lamps, fenders, rear door treatment (by the use of "insets" in the dies from which these are stamped), color combinations, etc.

The body was designed first. It is a real full-width 6-passenger car with seats some six to ten inches wider than the average today, anticipating the present trend toward even wider and more comfortable bodies. Running boards—as running boards—have been eliminated. They are not needed today, except to keep gravel by the front wheels from sand-blasting the rear fender. In room it compares well with today's $1,000 class of automobiles.

The tail of the car was laid out so that in back of the rear seat there could be accommodated a conventional six-cylinder engine complete with clutch, transmission and differential radiator, and all the accessories, with the engine located transverse of the frame instead of lengthwise to conserve room. The tail helps to make the cars look even longer than they actually are.

The body is not designed with integral built-in chassis frame. A separate frame unit works out better from an all-around cost and weight standpoint if the body may be used in cars of different wheelbases and powerplant arrangements. The separate frame structure provides much more flexibility for general car design and layout—not only between the different models, but also from year to year.

Added to this is the important factor that separate assembly of chassis and body is in line with and adapted to present production facilities, whereas integral body and frame construction is not.

In the two larger cars, conventional six- and eight-cylinder powerplant dimensions were used for the complete car layout. In this connection if a car company went into a program along these lines it wouldn't be a bad idea to look ahead and design some of the mechanical units so that they can be switched around to the back without trouble. This applies particularly to transmission and clutch. Engines can be the same anyway except for minor modifications, particularly in connection with the cooling system. A definite program looking toward the future and reducing next year's cost by means of this year's layout, might also produce an axle design modification which would make the axle applicable to both the front and the rear-engined jobs. The same thing applies to springs, hubs, brakes, etc.

Cooperation

Those are things which engineers today can take in their normal stride, pretty well. On mechanical units, as we have mentioned, the industry has long cooperated on design. During 1936, for instance, there were over two dozen makes and models of cars which used the same basic transmission parts.

It is not inconceivable that independent manufacturers might one of these days also cooperate on major body dies, spreading their cost over a larger production in that way. It costs anywhere from half a million dollars on up to make dies and tools for a new body, and that cost has to be distributed over the number of cars to be built.

There are no technical difficulties in the way of such cooperation between independent manufacturers. Individuality of appearance can be retained. Any desired departures in general body design would have stronger public support if they were backed by a number of manufacturers rather than an individual company.

There are, of course, personal equations that would have to be solved before such a program could be put into operation. The same attitude exisiting today on mechanical units would have to be applied to thinking on automobile bodies. Whether or not that is feasible even today is anybody's opinion. So far, however, efforts at cooperation between domestic automobile manufacturers have not been crowned with any notable success.

Interchangeable Use of Dies

The feasibility of the move on the other hand is indicated by the fact that the larger manufacturers use their body dies for more than one make and model of the various lines which they produce. The mere fact that this interchangeable use of dies is not noticed by the public is proof in itself that standardization of dies does not destroy individuality of appearance.

There are a lot of little tricks that can be used in this direction. Dies can be made of several pieces—composite dies, so to speak. In the bodies of the cars shown here, for instance, right front and left rear doors of all three can be made from the same set of dies by just lifting out the part which corresponds to the fender clearance in the rear door. The same is true of the left front and right rear door.

Body molding dies can be made separately—as they generally are today—and different inserts used for different lines of cars, adding to individuality.

As to the rear-engined car, itself, many savings could probably be achieved over a period of time by designing a car specifically for rear engine and that only. The tooling cost, however, would be pretty high for such a pioneering job—as on any car that is new from the ground up. Few manufacturers could afford it. The better way, engineers feel, is to compromise—allowing complete flexibility in either direction—toward more front or toward more rear-engined cars, as dictated by sales trends at the time.

Just Among Ourselves

Subject: *Beeswax*

AS rubber type to the printer and the stone-bender to the mason contractor, the red-tape stretcher to government circles: mythical instruments of non-precision which would be extremely useful at times and for which the need, when it is felt, is almost overwhelming.

The memorandum which appears below was actually written by the general manager of an aircraft manufacturing company. It has been circulating through various government offices by the carbon-copy route, and dragged from a wallet, has enlivened many an informal luncheon. Here it is:

To: Inspector of Naval Aircraft.

Subject: Beeswax.

Reference: (a) Navy Specification 52B4b, (b) William Shakespeare (Hamlet).

1. The Contractor has been informally advised that beeswax used in the construction of Naval Aircraft must be source inspected to Navy Specification 52B4b, reference (a), and that Commercial beeswax now in his plant is to be rejected for failure to comply with this requirement.

2. The Contractor does not profess to be an authority on bees, although his technical staff is often credited with having bees in its bonnet; his plant itself is one of a group familiarly known as the "Bee Hive"; and in common with other aircraft manufacturers, he has sometimes been painfully aware of the deep significance of Shakespeare's immortal "To bee or not to bee—that is the question," reference (b). The Contractor, on rare occasions, has even been stung.

3. Notwithstanding his narrow apidian experience, the Contractor has always subscribed to the well known Ellis Parker Butler theory that "Bees is bees" and the not so well known corollary "Beeswax is beeswax." He has been entirely unaware of the superior merits of beeswax procured from that most fortunate of specification-satisfying bees *Apis Mellifera Linne* (Fam. *Apidae*) described in reference (a). Moreover, his purchasing agent, one of the best and busiest beeswax buyers in the business, has been unable to locate a source of supply of beeswax conforming to these specifications.

4. In view of the fact that further delay will compromise the delivery date of the biggest bumblebee of them all, the XPBeeS-1, and convert the Contractor's workers into drones, he requests that the Inspector grant a deviation from the specifications, reference (a), or, failing this, advise the contractor of a source of supply of satisfactory beeswax. If the Inspector feels that this is beyond the limits of his authority, perhaps he will be willing to refer the matter of the *Bee*ureau of Aeronautics. Respectfully.

* * *

Australian Cars for Australians

THE Prime Minister of Australia continues his campaign for an "almost completely" Australian car. Bitterly opposed by the Chamber of Automotive Industries in New South Wales, which includes many of the importers of cars now brought into Australia, the project is supported just as vehemently by pro-administration newspapers and by the *Australasian Manufacturer*, influential and articulate organ of industrial solidarity down-under. Chief argument hinges on whether it will cost Commonwealth car buyers more to get a home manufactured car than cars made under the present schemes in effect.

Proponents of the home manufacture idea point out that as much as 80 per cent of some cars sold in Australia is manufactured there. Still to be made are engines, and it is contended that if bodies and tires can be made cheaply in Australia, so can engines.

There's only one hitch to this argument, as we see it. The Chinese have been casting metals for several thousand years, but we don't go to China for expert foundrymen. Newly industrialized countries find often that a program of self-supporting mechanization may founder in the foundry.—H. H.

How Much Automobile A

Listeners do well in remembering sponsorship of automobile radio programs but few are able to estimate prices of particular automobiles.

By Thomas G. MacGowan*

THE consumer, into whose ears automobile advertisers have long dinned their minimum f.o.b. prices, either has in his mind some very fantastic notions about what he would have to pay for most American passenger cars at the factory, or else—which is more often the case—he has no notion at all.

If he thinks anything about it, he usually thinks that almost all makes have higher base prices than they do. And he also believes that 15 out of 25 makes have higher-priced models than is the fact. On a few of the cars his price ideas are not far out of line, but on many of them they are weird indeed.

Men and women run a very even race in naming price ranges, with the women having a shade the better of it. Men, however, excel on the base prices. Women's all-over advantage comes from a superiority in naming top prices.

Consumers do rather well at sponsorship recognition of most automobile radio programs—but the longest, best-placed and costliest programs do not always rank the best in this regard.

Car buyers of both sexes and all ages cherish remarkably uniform ideas about which automobile companies spend the most on advertising—and which spend the least, but all consumers are far off, apparently, in ranking some of the companies as to money spent in print and on the air.

These findings highlight the results from several questions in our national survey to determine public consciousness to slogans, facts and claims advertised by automobile companies.

In addition, however, to testing the consumer's automobile advertising consciousness, we sought to discover whether he likes most automobile advertising and whether he finds it convincing. From this questioning we developed a picture generally favorable to the motor industry's advertising efforts—albeit a picture in spots liberally highlighted with condemnatory comment.

In testing consumers' knowledge of f.o.b. price ranges, we presented the 639 persons interviewed with a list of 25 makes of passenger automobiles, requesting that the at-the-factory base and top prices of each make be listed opposite it. The question was:

"What are the f.o.b. price ranges of these cars? (Fill in lowest and highest prices.)"

This was one of the most important of our many questions, both because of the emphasis on prices in motor advertising and because an automobile's success in reaching its proper market depends so much upon its ability to impress the public with its true price range. It was a fact, of course, that the bottom or base prices had received the benefit of featuring in advertising, whereas in most cases the prices at the top had been given little advertising prominence. Our testing, therefore, served both to reveal the extent to which f.o.b. base-price advertising had made the desired impression and the degree of actual consumer awareness of the facts regarding f.o.b. price ranges as a whole.

As might have been expected, a great many of the persons interviewed were unable or unwilling to hazard a guess when confronted with this question. The average percentage of failure to respond was, for all the cars listed, 66.22 per cent. Men didn't answer in 64.15 per cent of all cases; women in 75.49.

But it must be remembered that

* President, Facts, Inc.

Advertising Sticks?

Part 2

Part 1 appeared in the Nov. 7, 1936, issue of AUTOMOTIVE INDUSTRIES

Two more instalments, concluding this series, will appear in subsequent issues of AUTOMOTIVE INDUSTRIES.

these percentages represent the average of refusals to answer on *any one car*. The percentage of interviewees who refused to give price ranges for *all cars* was less than 25 per cent.

The actual responses, averaged for each car, show that people have a decided tendency to believe that f.o.b. prices—particularly the base prices—are higher than they are:

Thirteen cars were given higher average base and top prices than the true prices.

Eight were priced too high at the bottom and too low at the top of their ranges.

Two were priced too low at the base of the range and too high at the top.

Only two were given price averages that were too low at both ends of their ranges.

Summing it up another way, we find that 21 of the 25 base price averages were too high, and that 15 of the 25 top price averages were above the true figures.

As a general thing, the answers on base prices were closer to the truth than those on top prices. A rough indication of this is given by the fact that the average percentages of deviation from correctness are 13.7 for the former and 24.8 for the latter.

Besides indicating that well over half the people know nothing of price ranges, these findings, of course, show that, quite naturally, people have absorbed the heavily advertised base prices better than they have the figures at the top of the scale. It undoubtedly also shows that many persons have either failed to note or remember nationally advertised prices or that they confuse them with delivered prices, and that, in many cases, price reductions have not registered with the public.

The results were best of all for the lowest-priced cars, with medium-priced cars next best. If we eliminate Willys, which has really been in a special extra-low price field of its own, and which had the worst percentages of deviation of any car, irrespective of price, the results by price classes are as follows:

	Average % of Deviation From base price	From top price
Low-priced cars	9.0	14.4
Medium-priced cars	10.3	20.3
High-priced cars	22.7	30.2
Cars with models in both medium and high-price classes	18.0	35.6

Such a result is logical, in view of

Consumers' Ability to Give F.O.B. Price Ranges

[Table I]

		ALL PERSONS INTERVIEWED (639)							BREAKDOWN BY SEXES			
		Correct Price Range		Average Price Range Reported		% of Deviation			% of Deviation from Base Price		% of Deviation from Top Price	
		From	To	From	To	From base price	From top price	% of Failure to Respond	Men	Women	Men	Women
Cars Priced too HIGH (On both prices)	Willys	$395	$445	$564	$826	42.8+	85.6+	75.12	41.3+	56.2+	85.2+	86.5+
	Reo	795	895	911	1,462	14.6+	63.4+	75.43	14.1+	18.6+	65.4+	49.3+
	La Fayette	610	740	683	980	12.0+	32.4+	67.45	11.6+	13.3+	33.6+	23.2+
	Studebaker	665	1,065	768	1,350	15.5+	26.8+	66.82	15.9+	12.5+	27.8+	19.3+
	Nash	665	995	773	1,213	16.2+	21.9+	66.35	15.8+	18.6+	24.3+	8.5+
	Graham	635	1,170	788	1,254	24.1+	7.2+	72.30	24.1+	23.8+	7.7+	1.9+
	Hudson	710	975	792	1,155	11.5+	18.5+	68.23	11.1+	15.2+	19.2+	12.7+
	Chrysler	760	1,475	811	1,778	6.7+	20.5+	64.79	7.1+	4.5+	18.9+	29.9+
	Chevrolet	495	665	545	740	10.1+	11.3+	53.84	9.7+	12.7+	11.3+	12.2+
	Terraplane	595	740	634	837	6.6+	13.1+	65.73	5.9+	11.1+	13.5+	10.3+
	Hupmobile	795	1,175	848	1,318	6.7+	12.2+	75.59	8.2+	10.4+	12.5+	9.0+
	Oldsmobile	665	935	736	1,009	10.7+	7.9+	59.00	9.5+	16.7+	8.3+	5.5+
	Pontiac	615	865	663	904	7.8+	4.5+	58.69	7.6+	8.6+	5.0+	1.5+
Cars Priced too LOW (On both prices)	Pierce-Arrow	3,195	4,995	1,780	3,937	44.3−	21.2−	73.87	44.4−	43.0−	19.8−	32.1−
	Cadillac	1,645	7,750	1,585	3,555	3.6−	54.1−	66.67	3.2−	7.8−	54.7−	48.5−
Cars too HIGH (On base price) and LOW (On top price)	Lincoln	1,275	6,700	1,557	3,681	22.1+	45.1−	68.04	23.5+	12.4+	44.9−	46.9−
	Auburn	745	2,245	934	1,750	25.4+	22.0−	74.18	25.0+	30.1+	22.3−	20.0−
	Packard	990	5,050	1,053	3,041	6.4+	39.8−	62.91	7.2+	1.4+	39.6−	40.9−
	Buick	765	1,945	840	1,516	9.8+	22.1−	58.69	10.1+	8.2+	22.1−	21.6−
	Plymouth	510	895	560	772	9.8+	13.7−	57.28	10.0+	8.2+	14.1−	10.6−
	De Soto	695	1,095	724	1,036	4.2+	5.4−	68.08	4.3+	3.6+	5.7−	3.5−
	Dodge	640	995	665	945	3.9+	5.0−	60.25	3.1+	7.7+	5.2−	3.8−
	Ford	510	760	542	749	6.3+	1.4−	58.06	6.1+	7.5+	1.6−	.8−
Cars too LOW (On base price) and too HIGH (On top price)	La Salle	1,175	1,225	1,147	1,821	2.4−	48.7+	66.20	1.9−	6.4−	49.7+	36.2+
	Cord	1,995	2,195	1,593	2,534	20.2−	15.4+	74.02	19.0−	31.1−	16.6+	4.9+
	TOTAL	.....	.....	.....	.....	13.7	24.8	66.22	13.5	15.6	25.2	21.7

Consumers' Ability to Identify Sponsors of Automobile Radio Programs

[Table II]

ALL PERSONS INTERVIEWED (639)

PROGRAM	HOURS	DAY	CHAIN	SPONSOR	Correct Responses		Partially Correct Responses*		Incorrect Responses		Failures To Respond	
					No.	%	No.	%	No.	%	No.	%
Fred Waring and His Pennsylvanians	9:30-10 p.m. / 9:30-10 p.m.	Tues. / Fri.	CBS / NBC	Ford / Ford	401	62.76	....	.....	25	3.91	213	33.33
Ed Wynn, Graham McNamee and Pop. Orch.	9:30-10 p.m.	Tues.	NBC	Plymouth	246	38.50	35	5.48	65	10.17	293	45.85
Symphony Orch.—Victor Kolar, Cond.	9-10 p.m.	Sun.	CBS	Ford	244	38.19	....	.....	62	9.70	333	52.11
Popular Orch.—Richard Himber, Cond.	10-10:30 p.m.	Fri.	NBC	Studebaker	243	38.03	....	.....	43	6.73	353	55.24
Symphony Orch.—Erno Rapee, Cond.	10-11 p.m.	Sun.	NBC	General Motors	148	23.16	23	3.60	87	13.62	381	59.62
TOTAL					1282	40.12	58	1.82	282	8.83	1573	49.23

BREAKDOWN BY SEXES

PROGRAM	SPONSOR	Correct Responses		Partially Correct Responses*		Incorrect Responses		Failures to Respond	
		Men %	Women %	Men %	Women %	Men %	Women %	Men %	Women %
Fred Waring and His Pennsylvanians	Ford	64.56	54.70	....	.....	3.64	5.13	31.80	40.17
Ed Wynn, Graham McNamee and Popular Orchestra	Plymouth	37.74	41.88	6.13	2.56	10.54	8.55	45.59	47.01
Symphony Orchestra—Victor Kolar, Conductor	Ford	37.55	41.03	.....	.....	9.39	11.11	53.06	47.86
Popular Orchestra—Richard Himber, Conductor	Studebaker	39.66	30.77	.....	.....	6.13	9.40	54.21	59.83
Symphony Orchestra—Erno Rapee, Conductor	General Motors	23.18	23.08	3.83	2.56	12.64	17.95	60.35	56.41
TOTAL		40.54	38.29	1.99	1.02	8.47	10.43	49.00	50.26

* Mentions of Chrysler Motors as the sponsor of the Plymouth program and of one or some of the General Motors cars as sponsors of the General Motors program were listed as partially correct.

the heavier advertising and wider sale of the lower-priced makes. It does, however, indicate that medium- and high-priced cars have a long way to go before the public will have a reasonably good idea of their prices at the factory.

Although women were, as a whole, just a little better than men in naming automobile price ranges, men had the edge in giving base prices and, of course, these are really far more important than the top prices. There their average percentage of deviation was 13.5; that of women was 15.6. On the top prices men had an average error of 25.2 per cent; women of only 21.7 per cent. Women came closer on the base prices of nine of the 25 cars, and beat the men on top prices of 19 makes.

What cars are the best and what the worst in consumer price-scale recognition? To get an accurate idea of this it is best to consider base and top prices separately. However, taking both figures into account, the order in accurate pricing by consumers is this: Ford, Dodge, DeSoto, Pontiac, Oldsmobile, Hupmobile, Terraplane, Chevrolet, Plymouth, Chrysler, Hudson, Graham, Buick, Cord, Nash, Studebaker, LaFayette, Packard, Auburn, LaSalle, Cadillac, Pierce-Arrow, Lincoln, Reo and Willys.

Table 1 presents the complete results of this question, with the cars arranged in order of greatest average deviation and grouped in accordance with the character of the deviation—cars with both base and top prices too high being listed together, those with both prices too low following, and those having one price too high or low and the other price the reverse coming at the end.

It is also interesting to study the results for the price classes separately. Here are the average base and top price deviation percentages for the lowest price field in order of greatest deviation:

	Base Price		Top Price
Willys	42.8+	Willys	85.6+
LaFayette	12.0+	LaFayette	32.4+
Chevrolet	10.1+	Plymouth	13.7—
Plymouth	9.8+	Terraplane	13.1+
Terraplane	6.6+	Chevrolet	11.3+
Ford	6.3+	Ford	1.4—

Willys' actual price range has been from $395 to $445 at the factory; our interviewees' responses gave an average range of $564 to $826. It was clear that many of them still thought of the Willys as a car sold at its prices of several years ago; the limited advertising had made little impression on this preconception. Terraplane's ranking ahead of both Chevrolet and Plymouth was particularly surprising. It was also interesting to observe that, although Chevrolet had a lower base price than Ford, the consumer consensus is that the Ford minimum price is the lesser, and that Plymouth, with a top price of $895—highest in its class, is to the consumer a car whose models run only up to $772.

Here are the average percentages of deviation for the medium-priced cars, arranged in the order of greatest divergence from the true base and top prices:

	Base Price		Top Price
Graham	24.1+	Reo	63.4+
Nash	16.2+	LaSalle	48.7+
Studebaker	15.5+	Studebaker	26.8+
Reo	14.6+	Buick	22.1—
Hudson	11.5+	Nash	21.9+
Oldsmobile	10.7+	Chrysler	20.5+
Buick	9.8+	Hudson	18.5+
Pontiac	7.8+	Hupmobile	12.2+
Chrysler	6.7+	Oldsmobile	7.9+
Hupmobile	6.7+	Graham	7.2+
De Soto	4.2+	De Soto	5.4—
Dodge	3.9+	Dodge	5.0—
LaSalle	2.4—	Pontiac	4.5+

Here again almost all the deviations are on the plus side. In all probability, since some cars' prices are much better understood than are those of others, the errors did not come primarily from confusion with the delivered prices. Probably most of them may be traced back to impressions carried over from days when the cars sold in higher price ranges. In some cases, of course, great emphasis upon price has clearly had its effect. The most important lessons to be drawn from the reactions on medium-priced cars, however, come directly from the erroneous prices which are connected with them in the public mind. It is, for example, of the

utmost importance to know that Graham, selling as low as $635, is credited by the consumer with making no model to sell below $788, and that the public believes that LaSalle, with a 1936 top price of $1,225 at the factory, is priced all the way up to $1,821.

The results from this question fit in nicely with those on the number of cylinders possessed by the various makes of car. *Graham, for example, was believed to be an eight nearly as often as a six, and LaSalle was often identified as a 12, which it is not. In general, the cars with but one cylinder set-up had the smallest degree of price error, Dodge being an outstanding example.

In the group of cars which are entirely in the high-priced field, we may include only Pierce-Arrow, Cord and Cadillac:

	Base Price		Top Price
Pierce-Arrow.	44.3—	Cadillac	54.1—
Cord	20.2—	Pierce-Arrow.	21.2—
Cadillac	3.6—	Cord	15.4+

Pierce-Arrow, which in 1936 made no car to sell below $3,195, was thought by the people interviewed to have a base price of $1,780, and the opinions on Cord's lowest price, which was actually $1,995, averaged only $1,593.

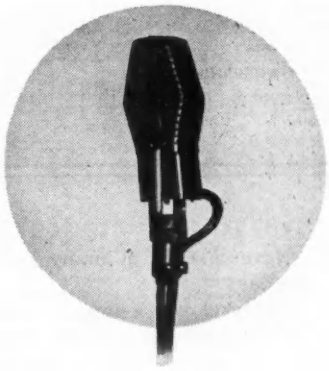
Consumers generally have little idea that the more expensive cars run into as high prices as they do, as is demonstrated in Cadillac's case. Here the top price was actually $7,750, but the average consumer's top price response was $3,555.

This same lack of knowledge of the top prices was shown in the price reactions on the cars which have models in both the medium- and high-priced fields:

	Base Price		Top Price
Auburn	25.4+	Lincoln	45.1—
Lincoln	22.1+	Packard	39.8—
Packard	6.4+	Auburn	22.0—

* This will be discussed in detail in the fourth article of this series.

Lincoln's big plus deviation on the base price comes, of course, through the fact that the Zephyr isn't yet fully established in the public consciousness as a medium-priced car. Packard, with a few more months behind it as a medium-priced producer, has its base price far more firmly entrenched in the car buyer's mind. While Lincoln's top-price cars cost $6,700 and were cheaper than those of Cadillac, this make got from our responders an average top price reaction of $3,681, more than $100 above the figure given for the latter.



The percentages of failure to respond were much the highest for the cars which do comparatively little advertising and have a relatively small sale, and, conversely, the heavily advertised large-selling cars had the smallest percentages. Thus at one extreme we find Hupmobile, with a percentage of 75.59, and at the other Chevrolet for which 53.84 per cent of the persons interviewed gave no price ranges.

So much for our study of the all-important matter of consumer price-consciousness and the somewhat disturbing conclusions to which it leads.

Now, how well are consumers able to name the sponsors of automobile radio programs? In seeking the answer to this question we offered the interviewees a list of the chain radio programs which were on the air at the time of the survey, each having listed after it its hours on the air, its day or days of broadcasting and the name of the chain or chains carrying it.

The interviewers used the following question:

"What automobile companies sponsor these programs?"

After each program the responders wrote the name of the sponsoring company—if they could.

They were rather better at doing this than at answering the other questions in the survey. The average percentage of failure to attempt an identification—49.23—was about the same as it was on the questions calling for identification of slogans and features. The average percentage of correct response, 40.12, was much higher than it was on those questions.

Women did not do quite as well as men, either in frequency of response or correctness of identifications, but the discrepancy between the sexes was less marked than in the cases of the earlier questions.

Three high points stand out in the study of Table II, in which the responses are presented in detail:

Fred Waring's Ford program had by far the largest and most accurate response. Broadcast twice each week and over two networks, this program was correctly identified with Ford by 401 persons, or 62.76 per cent of the 639 persons interviewed.

General Motors' Sunday evening hour-long symphony concerts conducted by Erno Rapee did the worst of any program, being identified by only 23.16 per cent of the persons questions.

The three other programs, Plymouth's Ed Wynn half-hour, Ford's hour of symphony music conducted by Victor Kolar and Studebaker's half-hour program by Richard Himber's orchestra did about equally well, with identification percentages, respectively, of 38.50, 38.19 and 38.03.

Women proved more successful than men in identifying the Plymouth program and the Ford Sunday evening symphony hour. They were much worse than men in naming the sponsors of the Ford program featuring Fred Waring and his Pennsylvanians and the Studebaker broadcast. They ranked just a shade below the men in recognizing General Motors as the sponsor of the Rapee symphony program.

Women's identification efforts leave the programs in the same order as that of the responses as a whole, but men

Consumers' Ranking of Automobile Company Advertising Expenditures

[Table III]

COMPANIES	ALL RESPONDERS Order of Rank	ALL RESPONDERS Average Rank	BY SEX Men	BY SEX Women	BY AGE 20 to 29	BY AGE 30 to 39	BY AGE 40 to 49	BY AGE 50 or over
General Motors Corp.	1	1.4	1.4	1.5	1.4	1.3	1.4	1.4
Ford Motor Co.	2	2.3	2.3	2.2	2.2	2.2	2.3	2.1
Chrysler Corp.	3	3.3	3.2	3.7	3.3	3.2	3.5	3.1
Packard Motor Car Co.	4	5.8	6.0	5.1	5.5	6.1	6.2	6.0
Studebaker Corp.	5	6.4	6.5	5.9	6.4	6.6	6.6	6.2
Hudson Motor Car Co.	6	6.9	6.9	7.0	6.7	6.9	6.9	7.3
Nash Motors Corp.	7	7.2	7.2	7.2	7.3	7.1	7.3	7.5
Graham-Paige Motors Corp.	8	8.8	8.9	8.6	8.7	8.8	8.8	9.5
Auburn Automobile Co.	9	9.0	9.0	9.1	8.9	9.1	8.9	9.2
Pierce-Arrow Motor Car Co.	10	9.5	9.4	9.9	9.8	9.4	9.6	8.8
Hupp Motor Car Co.	11	9.80	9.8	9.52	9.9	9.8	9.9	9.5
Reo Motor Car Co.	12	9.81	9.9	9.54	10.0	9.7	9.8	9.9
Willys-Overland, Inc.	13	10.6	10.7	10.0	10.9	10.6	10.5	10.3

do better with Himber's Studebaker half-hour than with any other except Waring's Ford broadcast.

A few people named "Chrysler Motors" rather than Plymouth, in identifying the program featuring Ed Wynn, Graham McNamee and a popular orchestra, and some named one or some General Motors cars, rather than General Motors itself, as sponsors of the Rapee concerts. These responses were tabulated as partially correct.

If we consider only the responses actually attempted, we find that the Waring program of Ford is also an easy winner in the percentage of correct identifications to all identifications attempted, but that Himber's Studebaker program moves into second place when failures to respond are omitted.

The good ratings of the Ford programs tie in well with the victory of the "Watch the Fords Go By" slogan on an earlier question, in view of the fact that this slogan has been used regularly in the Ford radio commercial announcements.

Asked to identify the low-ranking General Motors symphony program, 71 persons credited it to Ford; this was nearly half the number—148—that gave the right answer. On the other hand only 32 people wrongly credited the comparable and competitive Ford symphony program to General Motors, while 244 named Ford.

We also sought to measure recognition of transcribed automobile broadcasts with the question: "What other automobile companies have radio programs?" Chevrolet received 83 mentions to Ford's 23, although the two companies' spot broadcasts, both given over many independent stations, are comparable in scope. Other mentions were: Dodge, 39; Packard, 31; Chrysler, 24; Buick, 22; Hudson, 13.

We next sought to learn the ideas of our test-reaction car buyers and car prospects with regard to the ranking of passenger automobile companies as to the amounts of money spent for advertising. Again they were shown a check-list, which this time listed 13 companies in alphabetical order. They were asked:

"Which automobile manufacturers do you think spend the most for advertising? (Rate the companies 1, 2, 3, etc., in order of money spent—most, 1; next most, 2; etc.)."

The order of rank developed from the responses to this question appears in Table III. It is not possible for us to give the actual current ranking order for comparison, but it is fairly obvious that in certain respects the order in which the automobile companies' expenditures rank, in our interviewees' opinion, is at variance with the true order. Nevertheless, in many respects it is excellent.

We also developed average rankings. These, studied for the sex and age subdivisions, show interesting shades of opinion for each of the sub-groups.

In several cases there are changes from the average order of rank in these groups. These changes, however, are all among the companies at the bottom of the list.

The order given by the average responder was: General Motors, Ford, Chrysler, Packard, Studebaker, Hudson, Nash, Graham-Paige, Auburn, Pierce-Arrow, Hupp, Reo and Willys-Overland. At least so far as the "Big Three" are concerned, this ranking is probably correct. Among the others it is more or less evident that errors exist. However, complete figures on 1936 expenditures and appropriations are not available, and the 1935 expenditures cannot be told exactly enough for an accurate check on this question because figures on newspaper advertising and spot radio broadasting cannot be secured. In 1935 the order of total expenditures in magazines, farm papers and chain radio was: General Motors, Ford, Chrysler, Studebaker, Packard, Hudson, Nash, Auburn, Reo, Graham-Paige, Pierce-Arrow, Hupmobile and Willys.

As the final phase of our study we undertook to find out consumers' *opinions* of automobile advertising. Do they *like* it? Is it convincing, from their standpoint? And is it more or less convincing than other advertising, or equally so? What are the reasons for the views they hold?

Three questions covered these points. The first:

"Do you like most automobile advertising?"

Table IV gives in detail the responses to this question, and to the others in this group. The reaction here was predominantly a favorable one, with more than three-quarters of the responders—78.3 per cent—answering in the affirmative. Men's reactions were slightly more favorable than those of women, while among the age groups the one over 50 said "yes" the most often and the group from 30 to 39 gave the most "noes." Used car owners thought more highly of automobile advertising than owners of new cars or non-owners.

Consumers' Opinions of Automobile Advertising

[Table IV]

	Like most automobile advertising?		Think it generally convincing?		Think it more or less convincing than other advertising, or same?		
	Yes	No	Yes	No	More	Less	Same
TOTAL	78.3	21.7	62.5	37.5	39.9	18.1	42.0
BY SEX							
Men	78.4	21.6	63.4	36.6	41.7	17.5	40.8
Women	78.0	22.0	58.1	41.9	31.3	20.8	47.9
BY AGE							
20-29	78.5	21.5	62.9	37.1	43.1	16.9	40.0
30-39	72.3	21.7	57.6	42.4	33.8	15.9	50.3
40-49	83.3	16.7	68.9	31.1	41.7	22.4	35.9
50 up	84.4	15.6	63.3	36.7	27.6	31.0	41.4
BY CAR OWNERSHIP							
New	76.9	23.1	61.6	38.4	37.3	19.5	43.2
Used	82.4	17.6	64.9	35.1	45.2	14.7	40.1
None	74.0	26.0	60.0	40.0	36.8	20.6	42.7

In answer to the question: "Why? (or why not?)," we received the following responses from those who had answered "yes" to the question:

It is attractive and interesting	129
It is educational and instructive	89
They enjoy the illustrations	34
They like automobile radio programs	31
It is backed up by proven facts	24
It is concise and to the point	12
Other reasons	12

Those who didn't like automobile advertising gave these reasons:

Claims are exaggerated	45
All claims are too uniform, with each company claiming superiority	20
It is misleading as to price	14
It isn't impressive and lacks appeal	7
Other reasons	10

The next question was:

"Do you think automobile advertising is generally convincing?"

Here we find that fewer of the responders think the advertising convincing than like it generally. However, nearly two-thirds of them, or 62.5 per cent, said "yes" to the question.

The relatively greater disapproval of the women was more marked this time, with only 58.1 per cent of them giving affirmative answers as against 63.4 per cent of the men. The age group from 40 to 49 was the most favorable, and that from 30 to 39 again the most critical. Once more the used car owners

(Turn to page 760, please)

CLUTCH AND REAR AXLE

Line Number	CAR MAKE AND MODEL	CLUTCH: Make	Type Centrifugal or Semi-Centrifugal	Ventilated	Make—Power Unit	Vibration Insulation	No. of Driving Discs	No. of Driven Discs	FACINGS: Material	Inside Diam.	Outside Diam.	Thickness	No. Required	REAR AXLE: Make	Model	Type	Min. Road Clearance	LUBRICATION: Capacity (Pts.)	GRADE: Summer	GRADE: Winter	GEARING: Type	Ratio (Std.) 5 pass., 4 d. Sedan	No. of Teeth: Ring	No. of Teeth: Pinion	Pinion Adjustment	Pinion Bearing Adjust.	Pinion Bearing in sleeve	Back Lash (Average)	Line Number
1	American Bantam																												1
2	Auburn 654	Long			No		2	1	Mo	5¾	9	.137	2	Col		½	7½	4	165	165	SB	4.44	40	9	Scr	Scr		.004	2
3	Auburn 852	Long			No		2	1	Mo	5½	9¾	.137	2	Col		½	7½	4	165	165	SB	4.08	49	12	Scr	Scr		.004	3
4	Auburn SC-852	Long			No		2	1	Mo	5½	9¾	.137	2	Col		½	7½	4	165	165	SB	4.08	49	12	Scr	Scr		.004	4
5	Buick 37-40	Long	No	Yes	No	Sp	2	1	Wo	6	10	⅛	2	Own		½	7⅛	3(a)	160EP	90EP	Hyp	4.40	44	10	Shim	No	No	.009	5
6	Buick 37-60	Long	No	Yes	No	Sp	2	1	Wo	6½	11	⅛	2	Own		½	7¼	3(a)	160EP	90EP	Hyp	3.90	39	10	Shim	No	No	.009	6
7	Buick 37-80	Long	No	Yes	No	Sp	2	1	Wo	6½	11	⅛	2	Own		½	7⅛	4(a)	160EP	90EP	SB	4.22	38	9	Shim	No	No	.009	7
8	Buick 37-90	Long	No	Yes	No	Sp	2	1	Wo	6½	11	⅛	2	Own		½	8½	4(a)	160EP	90EP	SB	4.62	37	8	Shim	No	No	.009	8
9	Buick V8-60	Long			No		2	1	Wo	6½	11	.137	2	Own		½	8¼	5	Spec	Spec	Hyp	3.69	48	13	Shim	No	No	.006	9
10	Cadillac V8-65	Long			No		2	1	Wo	6½	11	.137	2	Own		½	8⅛	5	160EP	90EP	SB	4.30	43	10	Shim	No	No	.006	10
11	Cadillac V8-70	Long			No		2	1	Wo	6½	11	.137	2	Own		½	8⅛	5	160EP	90EP	SB	4.30	43	10	Shim	No	No	.006	11
12	Cadillac V8-75	Long			No		2	1	Wo	6½	11	.137	2	Own		½	8⅛	5	160EP	90EP	SB	4.60	46	10	Shim	No	No	.006	12
13	Cadillac V12-85	Long			No	No	2	1	Wo	6½	11	.137	2	Own		½	8⅛	5	160EP	90EP	SB	4.60	46	10	Shim	No	No	.006	13
14	Cadillac V16-90	Own			No	No	3	2	Wo	6½	11	.140	4	Own		¾	8⅛	6	160EP	90EP	SB	4.64	51	11	Shim	No	F	.006	14
15	Chevrolet Master	Own	No	Yes	No	Sp	1	1	Mo	6¼	9	⅛	2	Own		½	8½	4	Spec	Spec	Hyp	3.73	41	11	Stc	No	No	.006	15
16	Chevrolet Master De Luxe	Own	No	Yes	No	Sp	1	1	Mo	6¼	9	⅛	2	Own		½	8⅝	4	Spec	Spec	Hyp	4.22	38	9	Stc	No	No	.006	16
17	Chrysler Royal C-16			Yes	No	Sp	2	1	Wo	6	10	.125	2			½	8¼	3¼			Hyp	4.10	41	10	Shim	Shim			17
18	Chrysler Imperial C-14			Yes	No	Sp	2	1	Wo	6	10	.125	2			½	8⅝	3¼			Hyp	4.10	41	10	Shim	Shim			18
19	Chrysler Custom Imperial C-15			Yes	No	Sp	2	1	Wo	6⅛	11	.125	2			½	9⅛	6¼			Hyp	4.55	50	11	Shim	Shim			19
20	Chrysler Airflow C-17			Yes	No	Sp	2	1	Wo	6⅛	11	.125	2			½	9½	4			Hyp	4.30	43	10	Shim	Shim			20
21	Cord Front Drive 812	Long	SC		No	Sp	2	1	Mo	6	10	.137	2	Own	(Note)	Spec					SB	4.70	47	10	Shim	Shim	No	.004	21
22	De Soto S-3			Yes	No	Sp	2	1	Wo	6	10	.125	2			½	8¼	3¼			Hyp	4.10	41	10	Shim	Shim			22
23	Dodge D-5			Yes	No	Sp	2	1	Wo	6	10	.125	2			½	8¾	3¼			Hyp	4.10	41	10	Shim	Shim			23
24	Duesenberg 8	Long			No	Sp		2	Mo	6½	11	.137	4	Own		½		4	Spec	Spec	Hyp				Shim	No	Yes		24
25	Ford V8-60				No			1			8.5	.325	2			¾		2½			SB	4.44	40	9					25
26	Ford V8-85		SC		No			1			9	.140	2			¾		2½			SB	3.78	34	9					26
27	Graham Crusader 85	Ill				Sp	2	1	Mo	5½	7⅞	⅛	2	Spi		½	8¼	2	160EP	90EP	SB	4.55	50	11	Shim	No			27
28	Graham Cavalier 95	Long	SC			Sp	2	1	Mo	5½	8⅛	⅛	2	Spi		½	8⅝	2½	160EP	90EP	SB	4.45	49	11	Shim	No			28
29	Graham Supercharger 116	Long	SC			Sp	2	1	Mo	5½	8⅛	⅛	2	Spi		½	7	2½	160EP	90EP	SB	4.27	47	11	Shim	No			29
30	Graham Supercharger 120	Long	SC			Sp	2	1	Mo	5½	8⅛	⅛	2	Spi		½	7	2½	160EP	90EP	SB	4.27	47	11	Shim	No			30
31	Hudson 73	Own	Cen		Ben	Sp	2	1	Cork	5.37	8.62	.203	90	Own		½	8.437	3	110EP	90EP	SB	4.11	37	9	Shim	Shim	No	.0020	31
32	Hudson 74-5-6-7	Own	Cen		Ben	Sp	2	1	Cork	6.37	9.75	.203	108	Own		½	8.437	3	110EP	90EP	SB	4.11	37	9	Shim	Shim	No	.0020	32
33	Hudson 37-50	Long			No	Sp	2	1	Wo	6½	10½	.137	2	Own		½	8¼	5	Spec	Spec	Hyp	3.92	47	12	Shim	No	No	.006	33
34	La Salle Zephyr		SC					1						Own		¾					SB	4.44							34
35	Lincoln V-12							1																					35
36	Nash Lafayette 400-3710	B&B				Sp	1	1					2	Own	3710	½	7⅛	4	90	90	SB	4.11	37	9	Shim	Shim	No	.007	36
37	Nash Ambassador 6-3720	B&B				Sp	1	1					2	Own	3720	½	7¾	4	90	90	SB	4.11	37	9	Shim	Shim	No	.007	37
38	Nash Ambassador 8-3780	B&B				Sp	1	1					2	Own	3780	½	8.0	6	90	90	SB	4.10	41	10	Shim	Shim	No	.007	38
39	Oldsmobile F-37	B&B		Yes	No	Sp	1	1	Wo	5⅝	9¼	.125	2	Own		½		2½(a)			SB	4.37	35	8	Shim	No	No	.0065	39
40	Oldsmobile L-37	B&B		Yes	No	Sp	1	1	Wo	6	10	.125	2	Own		½		2½(a)			SB	4.37	35	8	Shim	No	No	.0065	40
41	Packard Six		SC		No	Sp	2	1		5¾	9½	.137	2	Own		½		5	Spec	Spec	Hyp	4.36	48	11	Scr		No	.004	41
42	Packard 120-C		SC		No	Sp	2	1		6	10	.137	2	Own		½		6	Spec	Spec	Hyp	4.09	45	11	Scr		No	.004	42
43	Packard Super Eight		Std		No	Sp	2	1		7	12	.140	2	Own		½	7¼	6½	Spec	Spec	Hyp	4.69	61	14				.004	43
44	Packard Twelve		Std		Ben	Sp		1		7	12	.187	2	Own		½	8⅛	6¼	Spec	Spec	Hyp	4.41	75	17				.004	44
45	Pierce-Arrow 1701	Long	Std		No	Sp		1	Mo					Own		½	7⅝	6	90EP	90EP	Hyp	4.58	55	12	Scr	Shim	Yes	.0025	45
46	Pierce-Arrow 1702	Long	Std		No	Sp		1	Mo					Own		½	7⅞	6	90EP	90EP	Hyp	4.58	55	12	Scr	Shim	Yes	.0025	46
47	Pierce-Arrow 1703	Long	Std		No	Sp		1	Mo					Own		½	7⅞	6	90EP	90EP	Hyp	4.58	55	12	Scr	Shim	Yes	.0025	47
48	Plymouth P-3			Yes		Sp		1	M-W	5⅝	9¼	.133	2			½	8¼	3¼			Hyp	3.90	39	10	Shim	Shim			48
49	Plymouth P-4			Yes		Sp		1	M-W	5⅝	9¼	.133	2			½	8⅛	3¼			Hyp	4.10	41	10	Shim	Shim			49
50	Pontiac De Luxe Six 37-28 CA	Own	Std		No	Sp		1	Mo	6	10	⅛	2	Own		½	8.0	3	160	90	SB	4.37	35	8	Shim	Shim	No	.003*	50
51	Pontiac De Luxe Eight 37-28 CA	Own	Std		No	Sp		1	Mo	6	10	⅛	2	OWn		½	8⅛	3	160	90	SB	4.37	35	8	Shim	Shim	No	.003*	51
52	Studebaker Dict. & Dict. Pl. 6	B&B	Std	Yes	No	Sp	2	1	M-W	5⅝	9¼	.133	2	Spi		½	7¾	3	Spec	Spec	Hyp	4.55	50	11	Shim	Shim	No	.004	52
53	Studebaker President	Long	Std	Yes	No	Sp	2	1	Mo	6	10	.137	2	Spi		½	7¾	3½	Spec	Spec	Hyp	4.55	50	11	Shim	Shim	No	.004	53
54	Terraplane 71	Own	Cen		Ben	Sp	2	1	Cork	5.37	8.62	.203	90	Own		½	8.43	3	110EP	90EP	SB	4.11	37	9	Shim	Shim	No	.002	54
55	Terraplane 72	Own	Cen		Ben	Sp	2	1	Cork	5.37	8.62	.203	90	Own		½	8.43	3	110EP	90EP	SB	4.11	37	9	Shim	Shim	No	.002	55
56	Willys 37	B&B	Std		No	Sp	2	1	Mo	5⅛	7⅞	.125	2	Own		½	8¼	1¼	190	150	SB	4.30	43	10	Shim	Shim	No	.007	56

*—Minimum ½—Semi floating
¾—Three quarters floating
(a)—Pounds instead of pints
B&B—Borg & Beck

Ben—Bendix
Cen—Centrifugal
Col—Columbia Axle Co.
EP—Extreme Pressure

F—Front
Hyp—Hypoid
Ill—Illinois
Mo—Moulded

MW—Moulded and Woven
SB—Spiral Bevel
SC—Semi-Centrifugal
Scr—Screw adjustment

Sp—Springs
Spec—Special
Spi—Spicer
Std—Standard

StA—Steel-Artillery Type
Stc—Shims and Tapered Collar
Note—Data given applies to front drive. Rear axle is tubular dead axle type.

TRANSMISSION AND UNIVERSAL JOINTS

Line Number	CAR MAKE AND MODEL	Make	Model	Shifting Mechanism: Make	Shifting Mechanism: Type	AUTOMATIC OVERDRIVE: Make	Lubrication: Capacity (Pts.)	Lubrication: Grade: Summer	Lubrication: Grade: Winter	TRANSMISSION GEAR RATIOS (To—1): In High	Overdrive	Second	Low	Reverse	Constant Mesh Gears	TYPE GEARS: For Second	For First	For Reverse	Synchronous Meshing Second and Third Gears?	LUBRICATION: Capacity (Pts.)	LUBRICATION: Grade: Summer	LUBRICATION: Grade: Winter	UNIVERSAL JOINTS: Make	Number Used	Type	Lubricated With	Drive Medium	Torque Medium	Line Number
1	American Bantam																		Yes										1
2	Auburn 654	WG		WG	Std	No	No	No	No	4.44		1.60	2.82	3.38	H,S	He	Sp	Sp	Yes		160	90	Mec	2	NB		Sp	Sp	2
3	Auburn 852	Det		Det	Std	No	No	No	No	4.08			2.87	3.75	H,S	He	Sp	Sp	Yes		160	90	Mec	2	NB		Sp	Sp	3
4	Auburn SC-852	Det		Det	Std	No	No	No	No	4.08			2.87	3.75	H,S	He	Sp	Sp	Yes		160	90	Mec	2	NB		Sp	Sp	4
5	Buick 37-40	Own		Own	Std	No	No	No	No	4.40	None	1.66	2.94	3.78		He	He	He	Yes	1¾	160	90	SB	1	PB	Aut	TT	TT	5
6	Buick 37-60	Own		Own	Std	No	No	No	No	3.90	None	1.53	2.39	2.39	H,S	He	He	He	Yes	2½	160	90	SB	1	PB	Aut	TT	TT	6
7	Buick 37-80	Own		Own	Std	No	No	No	No	4.22	None	1.53	2.39	2.39	H,S	He	He	He	Yes	2½	160	90	SB	1	PB	Aut	TT	TT	7
8	Buick 37-90	Own		Own	Std	No	No	No	No	4.62	None	1.53	2.39	2.39	H,S	He	He	He	Yes	2½	160	90	SB	1	PB	Aut	TT	TT	8
9	Cadillac V8-60	Own		Own	Std	No	No	No	No	3.69	None	1.53	2.39	2.39	S	He	He	He	Yes	2½	90EP	90EP	Mec	2	NB	PL	Sp	Sp	9
10	Cadillac V8-65	Own		Own	Std	No	No	No	No	4.30	None	1.53	2.39	2.39	S	He	He	He	Yes	2½	90EP	90EP	Mec	2	NB	PL	Sp	Sp	10
11	Cadillac V8-70	Own		Own	Std	No	No	No	No	4.30	None	1.53	2.39	2.39	S	He	He	He	Yes	2½	90EP	90EP	Mec	2	NB	PL	Sp	Sp	11
12	Cadillac V8-75	Own		Own	Std	No	No	No	No	4.60	None	1.53	2.39	2.39	S	He	He	He	Yes	2½	90EP	90EP	Mec	2	NB	PL	Sp	Sp	12
13	Cadillac V12-85	Own		Own	Std	No	No	No	No	4.60	None	1.53	2.39	2.39	S	He	He	He	Yes	2½	90EP	90EP	Mec	2	NB	PL	Sp	Sp	13
14	Cadillac V16-90	Own		Own	Std	No	No	No	No	4.64	None	1.47	2.40	2.49	L,S	He	Spr	Spr		4½	160	90	Mec	2	NB	PL	Sp	Sp	14
15	Chevrolet Master	Own		Own	Std	No	No	No	No	3.73	None	1.68	2.94	2.94	S	He	Spr	Spr	Yes	1¾	160	90	Own	1	PB	SL	Sp	TT	15
16	Chevrolet Master De Luxe	Own		Own	Std	No	No	No	No	4.22	None	1.68	2.94	2.94	S	He	Spr	Spr	Yes	1¾	160	90	Own	1	PB	SL	Sp	TT	16
17	Chrysler Royal C-16					Yes†	1			4.10	.7225	1.55	2.57	3.48		He	He	He		2¼				2	NB		Sp	Sp	17
18	Chrysler Imperial C-14					Yes†	1			4.10	.7225	1.55	2.57	3.48		He	He	He		2¼				2	NB		Sp	Sp	18
19	Chrysler Custom Imperial C-15					Yes				4.55	.7040	1.52	2.53	3.16		He	He	He		6¼*				2	NB		Sp	Sp	19
20	Chrysler Airflow C-17					Yes				4.30	.7040	1.52	2.53	3.16		He	He	He		6¼*				2	NB		Sp	Sp	20
21	Cord Front Drive 812	Own	4-speed	Ben	V&E	No	No	No	No	.638	.905 (b)	1.36	2.11	2.53		(c)	Spr	Spr		10(e)	(f)	(f)	Rze	4	Spec	CV	FSA	FSA	21
22	De Soto S-3					Yes†	1			4.10	.7225	1.55	2.57	3.48		He	He	He		2¼				2	NB		Sp	Sp	22
23	Dodge D-5					No	No	No	No	4.10	None	1.55	2.57	3.48	S	He	He	He	Yes	2¼				2	NB		Sp	Sp	23
24	Duesenberg 8	Own		Own	Std	No	No	No	No	3.78°		1.40	2.49	2.92		Sp	Sp	Sp		5			Spi	2	RM,M		Sp	Sp	24
25	Ford V8-60											1.765	3.071	4.015		He	He	Spr											25
26	Ford V8-85											1.604	2.820	3.625		He	He	He		2½									26
27	Graham Crusader 85	WG		WG	Std	No	No	No	No	4.55	None	1.426	2.43	3.24	S	He	Sp	Sp	Yes	1½	160	90	UP	2	NB		Sp	Sp	27
28	Graham Cavalier 95	WG		WG	Std	No	No	No	No	4.45	None	1.426	2.43	3.24	S	He	Sp	Sp	Yes	2½	160	90	UP	2	NB		Sp	Sp	28
29	Graham Supercharger 116	WG		WG	Std	WG†	2½	70	50	4.27		1.55	2.57	3.48	S	He	He	He	Yes	2½	160	90	UP	2	NB		Sp	Sp	29
30	Graham Supercharger 120	WG		WG	Std	WG†	2½	70	50	4.27		1.55	2.57	3.48	S	He	He	He	Yes	5	160	90	UP	2	NB		Sp	Sp	30
31	Hudson 73	Own		Ben	V&E	No	No	No	No	4.11	None	1.61	2.42	2.99		He	He	Spr	No	3	90EP	80EP	Spi	1	NB	Fib	Sp	Sp	31
32	Hudson 74-5-6-7	Own		Ben	V&E	No	No	No	No	4.11	None	1.61	2.42	2.99		He	He	Spr	No	3	90EP	80EP	Spi	1	NB	Fib	Sp	Sp	32
33	La Salle 37-50	Own		Own	Std	No	No	No	No	3.82	None	1.53	2.39	2.39	S	He	He	He	Yes	2½	90EP	90EP	Mec	2	NB	PL	Sp	Sp	33
34	Lincoln Zephyr				Std					4.44		1.60	2.82	3.62		He	He	He	Yes	2½									34
35	Lincoln V12																												35
36	Nash Lafayette 400-3710	Own	3710	Own	Std	WG	3	60(d)	50(d)	4.11	.708	1.63	2.72	3.35	S	He	Sp	Sp	Yes	3	90EP	80EP	Mec	2	NB	PL	Sp	Sp	36
37	Nash Ambassador 6-3720	Own	3720	Own	Std	WG	3	70(d)	50(d)	4.11	.708	1.55	2.57	3.48		He	He	He	Yes	3½	90EP	90EP		2	NB	PL	Sp	Sp	37
38	Nash Ambassador 8-3780	Own	3780	Own	Std	WG	3	70(d)	50(d)	4.10	.708	1.55	2.57	3.48		He	He	He	Yes	3½	90EP	90EP		2	NB	PL	Sp	Sp	38
39	Oldsmobile F-37	Own	F-37	Own	Std	No	No	No	No	4.37	None	1.66	2.94	3.78	S	He	He	He	Yes	2*	160	90	Mec	3	NB	PL	Sp	Sp	39
40	Oldsmobile L-37	Own	L-37	Own	Std	No	No	No	No	4.37	None	1.66	2.94	3.78	S	He	He	He	Yes	2*	160	90	Mec	3	NB	PL	Sp	Sp	40
41	Packard Six				Man	No	No	No	No	4.36		1.53	2.43	3.18	H,S	He	He	He	Yes	4	160	90	Mec	2	NB	PG	Sp	Sp	41
42	Packard 120-C				Man	No	No	No	No	4.09		1.53	2.43	3.17	H,S	He	He	He	Yes	4	160	90	Mec	2	NB	PG	Sp	Sp	42
43	Packard Super Eight				Man	No	No	No	No	4.69		1.52	2.46	2.88	H,S,L	He	He	He	Yes	4½	160	90	UP	2	NB	PG	Sp	Sp	43
44	Packard Twelve				Man	No	No	No	No	4.41		1.53	2.46	2.84	H,S,L	He	He	He	Yes	4½	160	90	Spi	2	NB	PG	Sp	Sp	44
45	Pierce-Arrow 1701	WG		WG	Std	WG				4.58	.705	1.70	2.83	3.40	H,S	He	He	He		4½	90	80	UP	2	NB	PL	Sp	Sp	45
46	Pierce-Arrow 1702	WG		WG	Std	WG				4.58	.705	1.70	2.83	3.40	H,S	He	He	He		4½	90	80	UP	2	NB	PL	Sp	Sp	46
47	Pierce-Arrow 1703	WG		WG	Std	WG				4.58	.705	1.70	2.83	3.40	H,S	He	He	He		4½	90	80	UP	2	NB	PL	Sp	Sp	47
48	Plymouth P-3				Std	No	No	No	No	3.90		1.55	2.57	3.48	S	He	He	He	Yes	2¼	160	90		2	NB	Fib	Sp	Sp	48
49	Plymouth P-4				Std	No	No	No	No	4.10		1.55	2.57	3.48	S	He	He	He	Yes	2¼	160	90		2	NB	Fib	Sp	Sp	49
50	Pontiac De Luxe Six 37-26 CA	Own		Own	Std	No	No	No	No	4.37	None	1.66	2.94	3.78	S	He	He	He	Yes	1¾	160	90	Mec	2	NB	PL	Sp	Sp	50
51	Pontiac De Luxe Eight 37-28 CA	Own		Own	Std	No	No	No	No	4.37	None	1.66	2.94	3.78	S	He	He	He	Yes	1¾	160	90	Mec	2	NB	PL	Sp	Sp	51
52	Studebaker Dict. & Dict. Pl. 6	WG		No	No	No	No	No	No	4.55		1.55	2.57	3.48	H,S	He	He		Yes				T'mp	2	Ru	None	Sp	Sp	52
53	Studebaker President	WG			Man					4.55		1.518	2.526	3.158	H,S	He	He				110	90	Spi	2	NB	PL	Sp	Sp	53
54	Terraplane 71	Own		Ben	V&E	No	No	No	No	4.11	None	1.61	2.42	2.99		He	He	Spr	No	3	90X	80X	Spi	1	NB	Fib	Sp	Sp	54
55	Terraplane 72	Own		Ben	V&E	No	No	No	No	4.11	None	1.61	2.42	2.99		He	He	Spr	No	3	90X	80X	Spi	1	NB	Fib	Sp	Sp	55
56	Willys 37	WG	T-84-C	No	No	No	No	No	No	4.30	None	1.426	2.43	3.24	S	He	Spr	Spr	Yes	1¼	160	90	UP	2	PB	Fib	Sp	Sp	56

°—Others also
†—At extra cost
*—Pounds instead of pints
(a)—With overdrive
AF—Anti-friction
Au—Automatic—from transmission
(b)—Third speed instead of overdrive
(c)—Helical on Second, Third and Fourth

CG—Chassis Grease
CV—Constant Velocity
(d)—Motor Oil
Det—Detroit Steel Products Co.
(e)—Rear Axle and Transmission Combined
(f)—Elco 100-31 EP
F-R—Front and Rear
Fib—Fiber grease

FSA—Front Suspension Arm
H—High
He—Helical
KH—Kelsey Hayes
L—Low or first
Man—Manual
Mec—Mechanics
Mo—Mola Steel

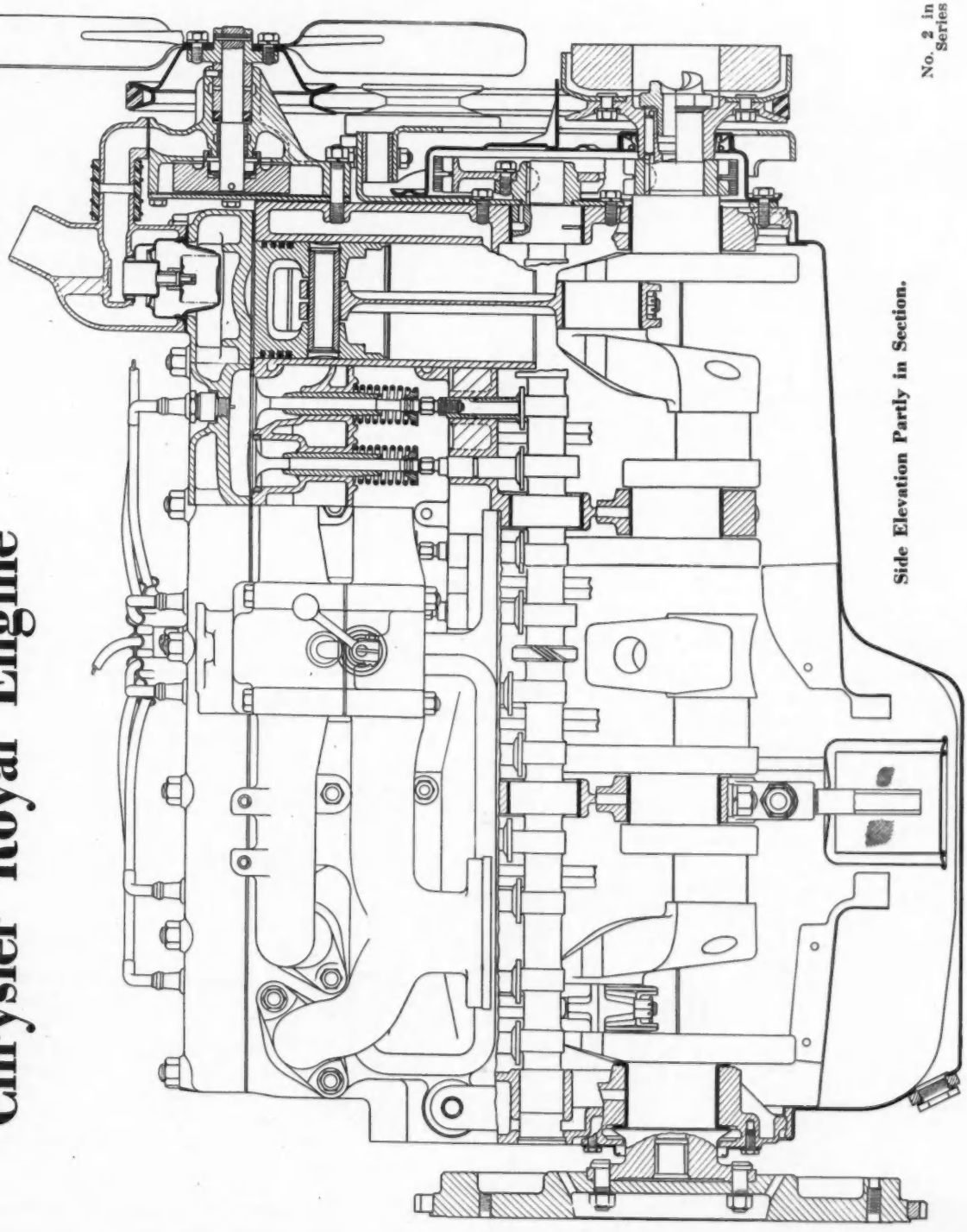
NB—Needle Bearing
O—Own
PB—Plain Bearing
PG—Pressure Gun
PL—Pre-lubricated
RM-M—Rubber and Metal and Metal
Ru—Rubber
Rze—Rzeppa

S—Second
SA—Steel Artillery
Sei—Seiberling
SB—Spicer-Buick Design
SL—Self Lubricated from Transmission
Sp—Springs
Spec—Special
Spi—Spicer

Spr—Spur Std—Standard
T'mp—Thompson Products
TT—Torque Tube
UP—Universal Products
US—U. S. Tires
V&E—Vacuum and Electric
Wd—Wire with Disk Covers
X—Extreme Pressure Lubricant

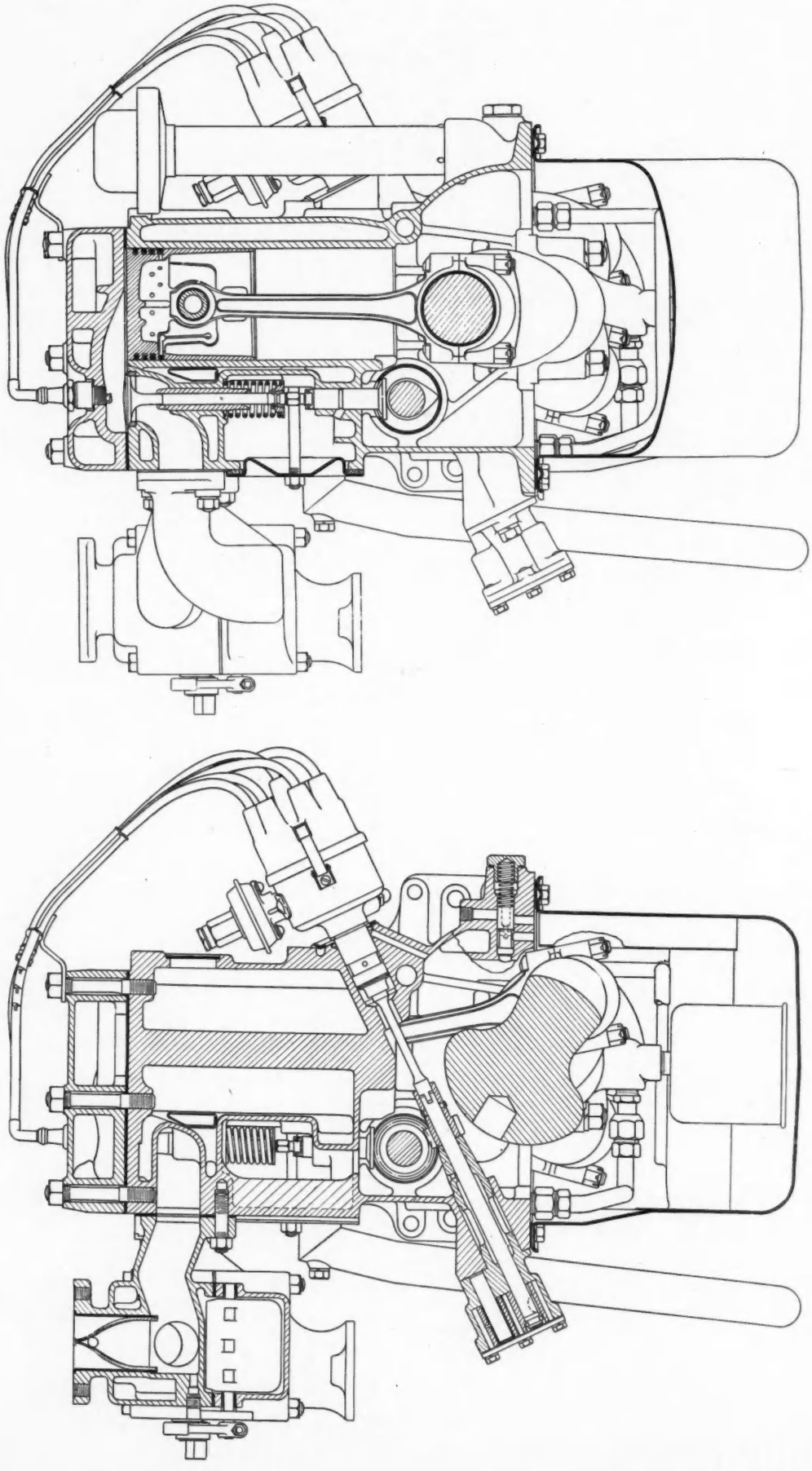
Chrysler Royal Engine

This six-cylinder engine is of 3⅜-in. bore by 4¼-in. stroke and is rated 93 hp. at 3600 r.p.m. With four-bearing counter-weighted crankshaft.

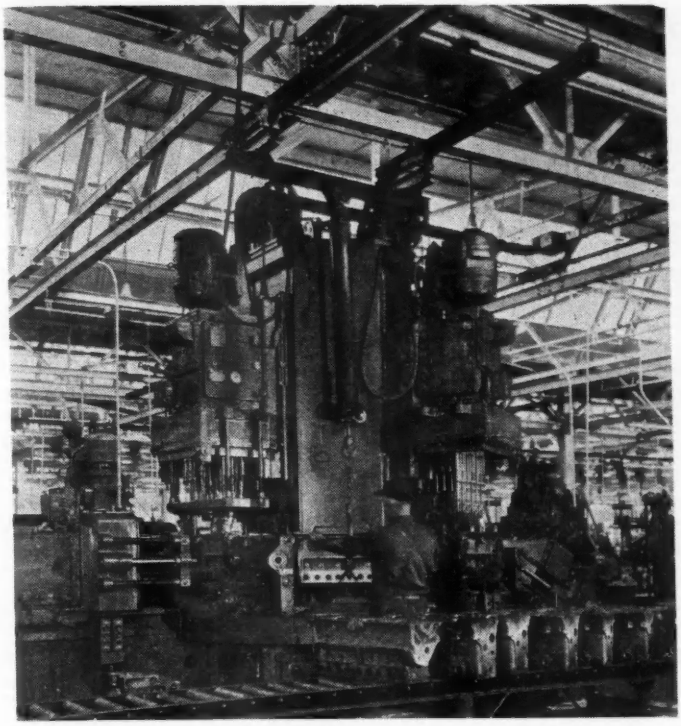


Side Elevation Partly in Section.

No. 2 in the AUTOMOTIVE INDUSTRIES Series of Engineering Drawings



Transverse Sections Between Cylinders and Through a Cylinder Axis



This huge machine performs 145 operations on the cylinder block of a Chrysler engine. It drills, reams and chamfers all holes in the bottom and manifold sides of the block and drills 12 angular holes through the tappet faces. It works on a rotating table revolving around a center column support. There are five working stations and one loading station. There are 10 electric motors to furnish power for the various operations, aggregating 92½ horsepower.

Production Lines

Powder Metallurgy

Much has been said in recent literature concerning the potentialities opened by the technique of powder metallurgy in which powdered metal under compression and incidental heat treatment is used for the production of synthetic alloys, and other combinations of metals. We learn from a recent issue of *Nickel Steel Topics* that powdered nickel is readily available for this technique. A recent application is that of making small permanent magnets of the new nickel-aluminum-cobalt alloys.

Saved $8,000

A manufacturer was faced with a problem when approximately 15 tons of metal froze in the cupola. Half of this metal was inside of the cupola and the rest of it extended from the cupola to the ground. Several attempts were made to remove the metal without any success. At the suggestion of an oxy-acetylene service operator it was decided that this metal could best be removed by means of the oxygen lance. While lance cutting of the frozen metal represented a somewhat more difficult job than usual, due largely to the low amount of steel present in the mass and the great amount of slag and coke, the entire charge was removed in about a day and a half.

Cast Cranks

Just because there has been a lull in news concerning cast alloy crankshafts, don't let it fool you. Many of the motor car companies have been watching this development and it is quite likely that at least one large producer will adopt the cast crank at least for part of its output, very soon. These cranks will be made of the nickel-moly alloy.

Plated Pins

Due to high bearing loads on the large diesel engines where weight is being scaled down, the main and con rod bearings are quite a problem. We are told that there is a good deal of experimental work going on with the chromium plating of crankshaft pins and journals. This type of finish produces a thin, but extremely hard and polished surface which is compatible with bearing materials and prolongs the life of the crankshaft and bearing. Incidentally, chromium plating may also be used advantageously for building up the journal diameter on worn shafts.

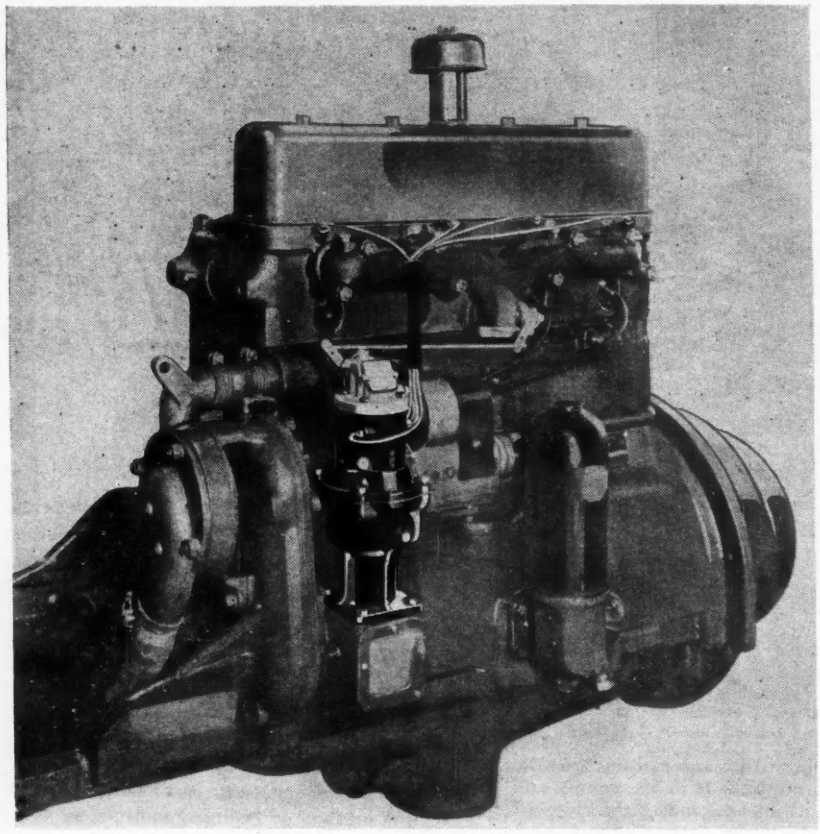
Boosts Average

As mentioned in the news section of AUTOMOTIVE INDUSTRIES recently, Ethyl Gasoline Corp. has just worked out a new method of rating gasolines so as to produce better correlation between the test method and behavior of gasolines in the car. The principle is new and requires some technical explanation for a complete understanding of it. To this end, Ethyl has prepared a technical bulletin entitled "Correlation of Laboratory Knock Testing Engine Ratings with Knocking in Automobiles." It's just off the press and only a limited number of copies have been distributed. We are assured by the technical department of the company that they will be glad to accommodate a reasonable number of requests for this bulletin from our readers. Take our word for it, this treatise will give you the whole picture of fuel rating in most lucid and understandable fashion.

Hydraulic Lifters

Gradually but surely the hydraulic valve lifter principle pioneered by Pierce-Arrow and subsequently improved and commercialized by Wilcox-Rich, is spreading in use on passenger cars. For 1937 the hydraulic valve lifter, in forms suitable for the specific application, will be found on Pierce-Arrow, LaSalle and Cadillac. Another form of hydraulic valve lifter has been adopted for the Lincoln 12.—J. G.

MANUFACTURING MANAGEMENT METALLURGY



Marvel fuel injection device in position on engine

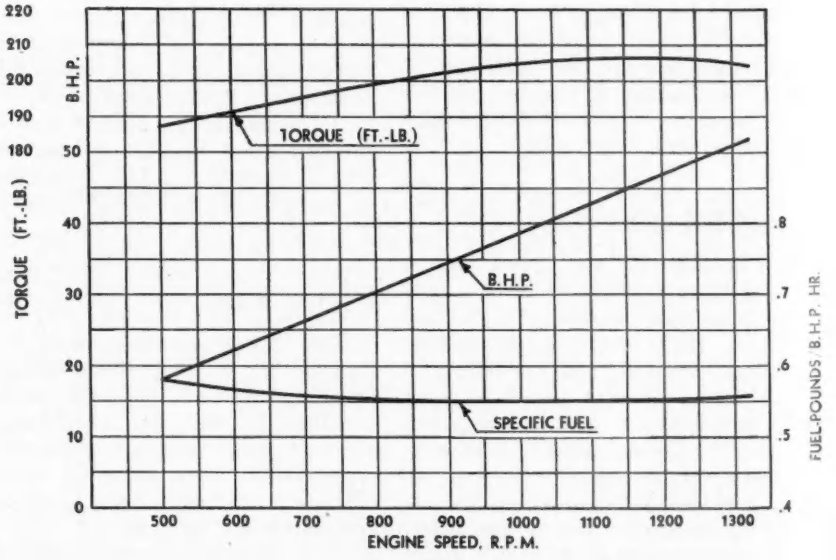
Injection

A LOW-PRESSURE fuel-injection system now in production by the Marvel-Schebler Carburetor Division of Borg-Warner Corporation, Flint, Mich., was designed to handle fuels ranging from gasoline to the heavier furnace oils. It was developed for intake-port injection in spark-ignition engines and is claimed to be self-compensating for load variations. Marvel has also developed a high-pressure injection system for Diesel engines, and has received an order for these from a leading manufacturer of automotive Diesel engines, for use on production engines. Continental Motors Corp. has adopted the low-pressure system for its radial air-cooled aircraft engine, and has been granted Department of Commerce ATC certificate No. 168 approving the use of the Marvel injector as standard equipment on this engine. Among the advantages claimed for the use of the system on aircraft engines are that it assures freedom from icing under low-temperature, high-humidity conditions, gives positive feed under all conditions in maneuvering, and has provision for altitude mixture-ratio adjustment.

The system may be used for injecting gasoline only, fuel oil only, or both fuels in the same engine. When used to inject gasoline only, the atomizing nozzles are located in the intake ports, the spray being directed either with or against the air stream. The duration of injection is substantially equal to the period of induction. It is not necessary to preheat the air, as the heat necessary for the vaporization of the fuel is drawn from the port walls, the intake valve, and the residual gas from the previous cycle. The resulting refrigerating effect assures a higher volumteric efficiency, and it is claimed that the uniformity of the charges delivered to individual cylinders permits of the use of higher compression ratios and thus adds further to the engine output.

When heavier fuels are injected, some heat must be supplied to the finely atomized spray. This is accomplished by providing a combustion-heated intake valve, or, alternately, by increasing the combustion-chamber temperature on the valve side. Where an engine is designed to operate on a variety of fuels from gasoline to furnace oil, the compression ratio is limited by the detonating tendency of the fuel of lowest octane rating. On the other hand, if the engine is designed to operate on gasoline only, the compression ratio can be increased and the output stepped up.

Pressure lubrication from the engine oil line is provided for each plunger of the pumping unit. The oil thus supplied seals the plungers against fuel leakage, and where gasoline is the fuel handled,



Graph showing record made with Stanolex No. 1 fuel oil. Engine governed at 1300 r.p.m.

System to Handle Fuels of All Grades at Low Pressures

it also acts as the lubricant. It is delivered to the lower of the two grooves on each plunger, the upper groove serving to collect the fuel that may find its way down the plunger, and to return it through a duct to the fuel supply. As the pressure of the oil in the lower groove is higher than the pressure of the fuel in the upper groove, any leakage that takes place past the plunger between the two grooves will be of oil working upward. The lower end of the plunger is lubricated by oil working downward, while other moving parts of the injector are lubricated by oil fed under pressure to the camshaft or by oil spray. Oil that has accumulated in the pump housing is drained off to the engine crankcase, to be used over.

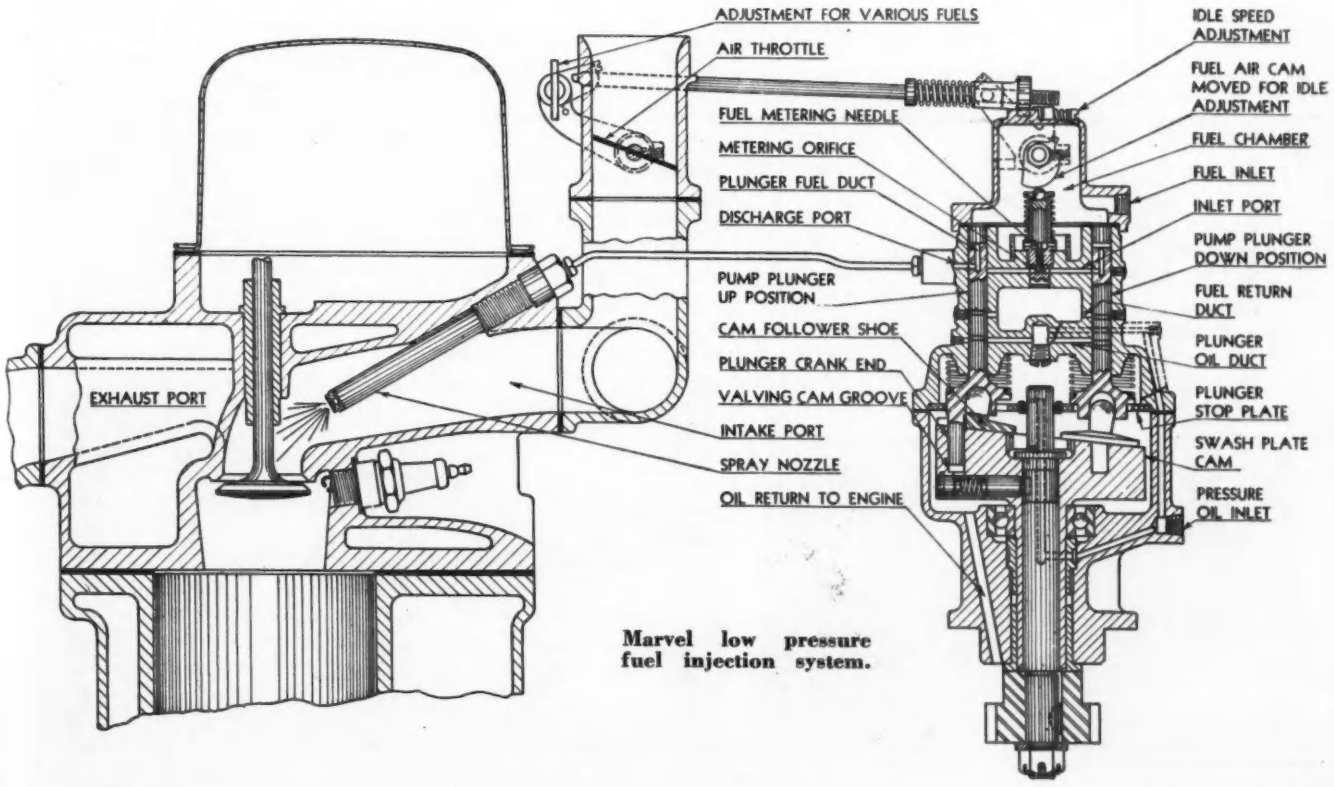
Metering for all of the pumping units is effected at a common center on the intake side, by means of a needle-controlled orifice in the inlet passage from the fuel chamber. Fuel may be fed by gravity, or if the fuel tank is below the injector level it may be fed by a transfer pump. In some installations the fuel is recirculated by means of a return line to the fuel tank. The air throttle and the metering needle are interconnected and both open and close together, which assures compensation for change in engine load. For instance, if the load on the engine is decreased, the speed will increase and the same quantities of air and fuel supplied to the engine will be divided between a larger number of cycles.

There is a positive linkage between the air throttle and the metering needle which incorporates what is referred to as a "fuel-air" cam that is effective throughout the range up to wide-open throttle. The idling mixture is adjusted by raising or lowering the fuel-air cam. Where a governor is used, it is connected to the fuel-air linkage. The shape of the fuel-air cam is generated by determining, for each degree of throttle opening, the lift of the metering needle which will give a correct proportion of air and fuel. A cam made in accordance with this table is applicable to all engines of generally similar characteristics.

For aircraft service the fuel-air cam is made with a warped surface and arranged to be moved axially, and this axial movement provides a manual mixture control to compensate for the lower air density at high altitudes. For engines designed to burn a variety of fuels, a latch in the linkage is arranged to make it possible to vary the length of the control lever so as to give the correct fuel curve for each fuel used.

The pumping unit is of the swashplate type, with the various pumping units arranged in cylindrical form. The plungers are moved by the revolving swashplate in one direction and are returned by springs. An oscillating motion of the plungers, for valving purposes, is effected by trailing crank ends

(Turn to page 762, please)



Marvel low pressure fuel injection system.

New DEVELOPMENTS

Automotive Parts, Accessories and Production Tools

Hand Drill

Pneumatic Tool By Buckeye Weighs Only 4½ Lb.

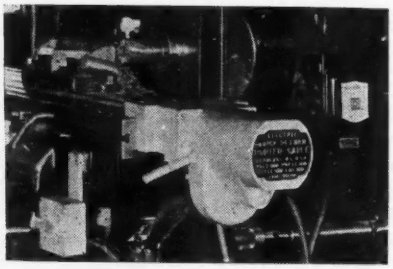
The Buckeye Portable Tool Co., Dayton, Ohio, has brought out the new Hercules pneumatic portable drill which is especially adaptable in the fabrication of bus bodies and airplanes. Specifications of the drill include drilling capacity ¼ in., speed 2200 r.p.m., weight 4½ lb. and an overall length of 12 in.

A light weight machine has been achieved through the use of specially light, strong alloys. An air motor operates the chuck spindle direct through planetary gears and the tool has ball bearings throughout. Smooth operation of the air motor is claimed to reduce drill breakage to a minimum.

Electric Recorder

Extensometer Fitted to Apparatus Developed by Tinius-Olsen

A new high magnification electric elongation and compression recorder has been developed by the Tinius-Olsen Testing Machine Co., Philadelphia.

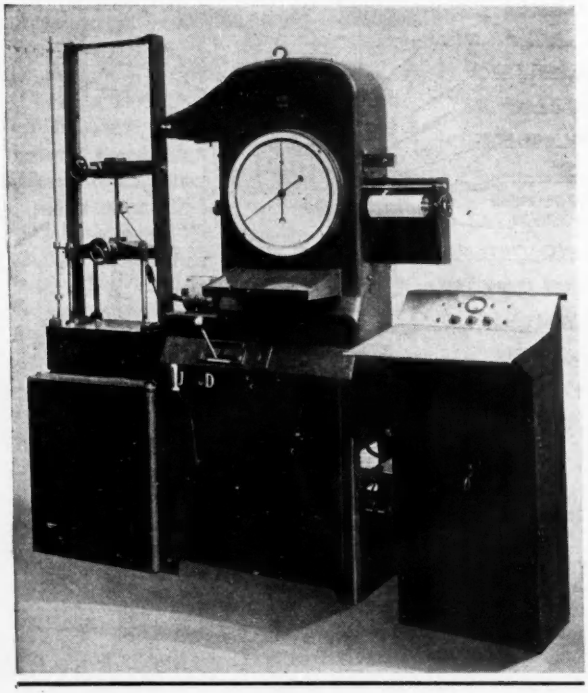


Porter-Cable return device

This apparatus can be equipped with Extensometers which are available in various sizes to take specimens up to ¾ in. in diameter.

The instrument illustrated is arranged for a standard specimen 2 in. in gage length and has three ranges of magnification. The ranges in the standard instrument are (taking into account the 2-in. gage lengths) 2000, 1000 and 500. The company claims that changes from one range to another can be accomplished in less than 60 sec. The device can be supplied for any three ranges having the ratio of 1, ½ and ¼.

For compression testing the same recorder can be used not with the Extensometer, but with a suitable compression meter.



(Left) Tinius - Olsen electric recorder set-up. (Below) Hercules hand drill

Governor

Device Adaptable To All Engines Using 1¼ In. Carburetors

A universal type governor known as the Vari-Speed type V-5 has been announced by the Handy Governor Corp., Detroit. The new model can be adjusted to any desired speed. It is universally adaptable to all engines requiring or using 1¼ in. carburetors.

All of the basic developments and the patented features utilized in previous Handy models are embodied in the V-5 governor. It has cam control for correlating velocity and vacuum forces, and a controlling spring — together with the cam — establishes a balance that is said to provide accurate and exact governing.

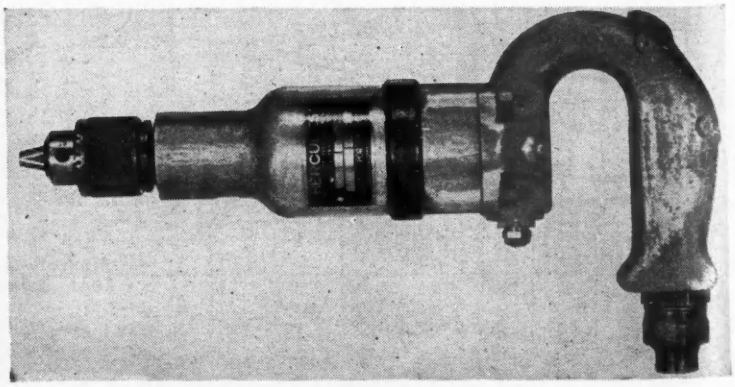
The device is simple in construction, the main units being simply a valve, cam and spring. Specially developed needle bearings carry the throttle shaft which is the only moving part; the throttle plate supplies the operating power.

Quick Return Device

Milling Machine Accessory Developed by Porter-Cable

An electric quick return mechanism for use on production milling machines built particularly in the years from 1912 to 1921, and on milling machines built since that time on which no quick return feature has been incorporated, has been developed by the Porter-Cable Machine Co., Syracuse, N. Y. The device cannot be used on the rack type of milling machine.

The accessory is mounted on the machine by special brackets. Driving is done through gears to the safety clutch on the feed screw of the machine. If the carriage should jam, the clutch will slip and no damage to the milling machine or motor will occur. The motor operates at 1800 r.p.m. through a gear reduction of 2½ to 1, giving an approximate table travel of 30 ft. per min.



"Jack-knifing" in the Operation of Trailers

(Continued from page 741)

against skidding and jack-knifing. One reason for this is that the greater the amount of braking effort obtained from the trailer wheels, the less will be required from the tractor wheels and the smaller therefore the chance of locking the tractor drive wheels. Besides, the greater the trailer braking force the smaller will be the push of the trailer against the coupling pin during the braking period.

It is therefore evident that, considered solely from the standpoint of protection against jack-knifing, the trailer brakes should be made as effective or as powerful as possible. This involves difficulties, however, for the reason that the gross load of the trailer varies within such wide limits. If the trailer brakes were made powerful enough to be able to lock the wheels under full load, these wheels would practically always be locked when the trailer was braked while lightly loaded, which would not be "healthy" for the trailer tires, nor conducive to the maintenance of road pavements. In fact, on the Pacific Coast, where tractor-trailer combinations are in extensive use, operators habitually brake only lightly on the trailers, as they have found that doing otherwise results in a very unpleasant chatter of the trailer and its coupling when the wheels are locked, and in the formation of corduroy or washboard road surfaces, particularly in the case of tarred roads.

Separate Brake Controls for Tractor and Trailer

With power-operated brakes it is quite feasible to provide separate controls for the brakes on the tractor and trailer, respectively. This applies to brakes operated by vacuum boosters, air-cylinders or chambers, and by electro-magnets. If there is a separate control for the trailer brakes, not only can the driver apply these brakes before he applies the tractor brakes, but he can also vary the force of application of the trailer brakes in accordance with the load on the trailer wheels, so as to utilize to the full the adherence of these wheels without producing the undesirable effects of locked wheels. It has been found that if air brakes on tractors and trailers are supplied from a single air tank located on the tractor, owing to the longer air lines to the trailer brakes, application of the latter has a tendency to lag behind application of the tractor brakes, which is the exact opposite of what is needed to prevent jack-knifing. For this reason a practice has grown up of providing trailers with a separate air tank.

When separate control of brakes on tractor and trailer is provided, one set is operated by hand and the other by foot. To operate the two controls so that the trailer brakes will become effective first and both sets produce substantially the maximum possible retardation without locking the wheels, calls for considerable skill, no doubt.

Another thing that has an effect on the tendency of a tractor-semi-trailer combination to jack-knife is the location of the center of the fifth wheel relative to the rear-axle axis. For a long time it was the general practice to place the center of the fifth wheel directly over the rear axle. With this arrangement, all of the trailer weight carried by the tractor is carried on the rear wheels of the latter. Whenever the retarding force of the trailer brakes per unit of trailer weight is less than the retarding force of the tractor brakes per unit of tractor weight (which is the usual case), the resulting push of the trailer against the coupling pin will be a factor in starting a jack-knife. Its influence will be the greater the longer the lever arm through which it acts, in other words, the further to the rear the coupling pin is located. From the standpoint of safeguarding against jack-knifing, it is advisable therefore to locate the coupling pin well ahead of the rear axle. This forward location of the coupling pin is made desirable also because of its effect on load distribution. As the tractor front tires ordinarily have half the load capacity of the tractor rear tires, it is desirable that under full-load conditions the total load on the tractor wheels should be divided in the proportion of one-third on the front tires to two-thirds on the rear tires.

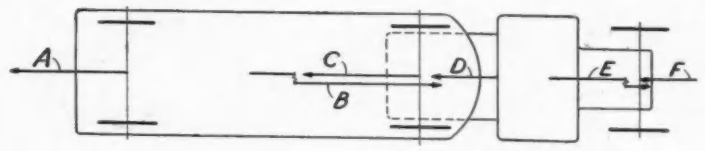


Fig. 4—Forces on tractor and trailer when brakes are applied to all six wheels (unstable equilibrium)

A, retarding force due to trailer brakes; B, inertia force due to weight of trailer; C, retarding force due to brakes on tractor rear wheels; D, rearward push of tractor on coupling pin; E, inertia force due to weight of tractor; F, retarding force due to tractor front brakes. $B = A + D$. $E = C + F - D$.

Location of Fifth-Wheel Axis

This distribution is hard to obtain unless the forward support of the trailer is located ahead of the tractor rear-axle center. Every condition therefore seems to favor the practice of locating the coupling pin ahead of the tractor axle, which has now become quite general. It will be readily understood that when the tractor and trailer axes make an angle with each other and the trailer pushes against the tractor through the coupling pin, a certain component of this push or force is in a direction parallel to the tractor rear axle; if the coupling is directly over the tractor rear axle, the whole of that lateral force tends to cause the tractor rear wheels to slide or skid sideways, whereas if it is ahead of the rear axle, part of the force only tends to skid the rear wheels.

Just what is the best location of the coupling pin relative to the tractor rear axle is not so easily settled on the basis of its effect on jack-knifing. A better basis on which to determine it is that of weight distribution. With a six-wheel combination using tires of the same size all around, singles on tractor-front and duals on tractor-rear and on trailer wheels, the best weight distribution would seem to be 20:40:40, and if the weights on the front and rear wheels of the tractor are known, as well as the length of the trailer body and the maximum gross weight of the trailer, then the proper location of the coupling pin to effect a 20:40:40 distribution can be readily determined.

How Much Automobile Advertising Sticks

(Continued from page 750)

had the least criticism to offer.

Here are the reasons advanced by those who found automobile advertising generally convincing:

It is backed up by proven facts	85
It is educational and instructive	48
It is attractive and interesting	23
They enjoy the illustrations	12
It is concise and to the point	12
Other reasons	17

The reasons of the dissenters run this way:

Claims are exaggerated	78
All claims are too uniform, with each company claiming superiority	39
Demonstrations are a better way to convince	17
It is misleading as to price	7
Other reasons	18

The last question:

"Is it more or less convincing than other advertising, or the same?"

The picture here is also generally favorable. The answers: more, 39.9 per cent; less, 18.1 per cent; and the same, 42.0 per cent. In other words, although only 62.5 per cent of the people thought automobile advertising convincing, 81.9 per cent considered it at least as convincing as other advertising.

Women were much less favorably inclined than were men, and the reactions of the age groups followed, in general, the previous pattern, except that the group aged 50 and more were this time the most critical.

The reasons, less numerous here, follow exactly the same pattern as those given on the previous question.

Many Changes in 1937 Car Prices in Canada

Many changes are noted in the new Canadian prices on 1937 motor cars. Comparative figures as far as are obtainable for 1936 and 1937 are as follows:

Delivered Prices of Coach Models in Toronto, Ont. (License Included)

	1937 Prices	1936 Prices
Ford—60 h.p. (Stand.)	$798	....
Ford—85 h.p. (Stand.)	843	$808
Chevrolet (Master)	823	817
Chevrolet (De Luxe)	920	953
Plymouth (2-door Sedan)	907	947
Plymouth (Touring Sedan with trunk)	929	932
Terraplane (De Luxe)	1,026	1,016
Terraplane (Custom)	1,145	1,125
Pontiac (224-6)	1,016	1,158
Dodge (Tour. Coach) De Luxe	1,016	1,024
Dodge (Tour. Coach) Custom.	1,097	1,129
Nash-400	1,065	1,171
Studebaker (Dictator)	1,152	1,154
Oldsmobile Six (De Luxe)	1,181	1,194
Hudson Six (122 inch)	1,241	1,191
Hudson Eight (122 inch)	1,303	1,253
De Soto (Custom)	1,207	1,298
Studebaker (President)	1,520	1,740
Packard (Six)	1,375	....
Packard (One Twenty)	1,620	1,655
Buick 40 Series	1,317	1,368
Buick 60 Series	1,641	1,710
Nash Ambassador Six	1,265	1,325
Nash Ambassador Eight	1,422	1,476
Chrysler Royal Six	1,204	1,284

MARVEL-SCHEBLER

Presents

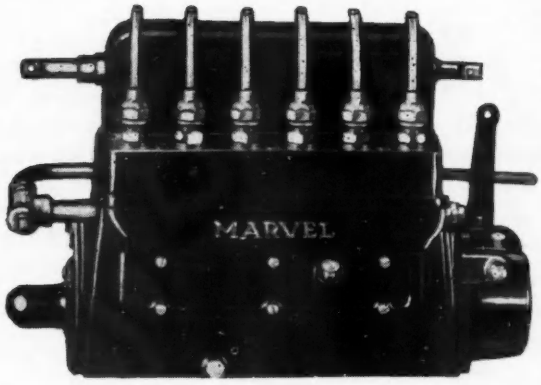
ADVANCED CARBURETORS AND FUEL INJECTORS FOR ALL PURPOSES

CARBURETORS FOR:

AUTOMOBILES - TRUCKS
TRACTORS - MARINE - MOTORCYCLES
INDUSTRIAL - AIRPLANES

LOW PRESSURE FUEL INJECTORS FOR:

(GASOLINE OR FUEL OIL)
TRUCKS - TRACTORS
MOTOR COACHES - AIRPLANES



HIGH PRESSURE FUEL INJECTORS FOR:

Standard Diesel and spark ignited Oil Engines.

MARVEL-SCHEBLER CARBURETOR DIVISION

BORG-WARNER CORPORATION

Manufacturers of: Marvel-Schebler-Johnson and Rayfield Carburetors, Marvel Fuel Injectors

FLINT, MICHIGAN

Injection System to Handle Fuels of All Grades at Low Pressures

(Continued from page 757)

projecting below the cam follower shoes, in an eccentric groove sunk in the top surface of the swashplate cam.

The two motions imparted to the plungers cause the ducts at the tips of the plungers to register with the intake ports, as is shown at the right in the illustration. In this position the spring above the foot of the plunger draws the plunger downward to draw in the fuel charge. At the bottom of the stroke the crank end of the plunger, trailing in the eccentric grooves, rotates the plunger until the duct at the tip registers with the discharge port, as at the left in the illustration. From this position the swashplate cam picks up the plunger and returns it to the top of the stroke to discharge the fuel. The crank end on the plunger, trailing in the cam groove, then returns the plunger to intake registry to repeat the cycle.

The fuel-air proportion for open-throttle operation of the engine is a function of the plunger stroke. This stroke can be varied by limiting the return of the plunger by having its foot arrested by a ledge or stop plate. If the plate is raised, the stroke is reduced, and if it is lowered the stroke is increased. When the right quantity of fuel for wide-open-throttle operation is obtained, the plate is positively locked in position. To enable the swashplate cam to travel beyond the position corresponding to the return of the plungers, as determined by the stop plate, the ball ends on the cam follower shoes leave the sockets in the foot of the plungers. On rotation the lift side of the swashplate cam raises the cam follower shoes until the ball ends of the shoes again engage the sockets in the plungers to carry them to the limit of their travel during the discharge stroke.

The duration of the fuel spray from the nozzles is determined by the angle of the swashplate cam in relation to its axis, and by the point in the cam lift from which the plungers are engaged and carried from the stop plate to the end of their discharge stroke. As the injector on a four-cycle engine is driven at half engine speed, the duration of injection at wide-open throttle of the injector is held to approximately 90 deg., which would correspond to the 180-deg. induction stroke of the engine. In part-throttle operation, the duration of spray from the nozzle is shortened by the characteristics of the metering system, and in practice the spray is timed to favor the early end of the suction stroke of the engine.

From each discharge outlet of the injector a tube leads to a spray nozzle in an engine intake port. The spray nozzles are of the centrifugal type and have valves that are opened by the fuel pressure. It is stated that the tangential spray ducts and the final orifice of the nozzle are each four times as large as the free passages through a 100-mesh screen. Such a screen is used as a fuel strainer on the intake side of the injector to protect the system against foreign matter.

The low pressure at which this injection system operates is made possible partly by the long duration of the spray and partly by the large tangential ducts and final orifice of the spray nozzles. Advantages claimed as resulting from the use of a low injection pressure are long life of moving parts and a reasonable first cost of the system.